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THIRTEENTH REPORT

OF THE

STATE BOARD OF HEALTH

OF THE

STATE OF NEW HAMPSHIRE

FOR THE

FISCAL YEAR 1894 AND TO JULY 1, 1895.

CONCORD:
EDWARD N. PEARSON, PUBLIC PRINTER.
1895.

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VIRGINIA

STATE OF NEW HAMPSHIRE.

OFFICE OF THE STATE BOARD OF HEALTH,

STATE HOUSE, July 1, 1895.

To His Excellency the Governor and the Honorable Council:

I have the honor to present herewith the Thirteenth Annual Report of the State Board of Health.

Respectfully submitted:

Irving A. Watson

Secretary.

28762

MEMBERS OF THE BOARD.

GOVERNOR JOHN B. SMITH . . .	Hillsborough.
ATT'Y GEN. E. G. EASTMAN . . .	Exeter.
G. P. CONN, M. D., *President* . . .	Concord.
JOHN J. BERRY, M. D.	Portsmouth.
IRVING A. WATSON, M. D., *Secretary*	Concord.

JAMES A. WESTON.

BORN AUGUST 27, 1827.

DIED MAY 8, 1895.

When the State Board of Health was created in 1881 Ex-Gov. James A. Weston was appointed its civil engineer, which position he ably and creditably filled to the date of his death. Almost invariably present at the meetings of the board, he took a deep interest in its work, as well as in all matters pertaining to the welfare of the people. Possessing a judgment of remarkable clearness and discretion, he served the board, as he did every trust imposed upon him, with a fidelity born of an unselfish devotion to duty. With tender memories we sorrowfully bow to the irrevocable edict which has taken from this board a beloved associate, and from the state one of her most useful and honored citizens.

REPORT.

Owing to the inability of the secretary to place in the hands of the public printer the material for this report in season to have it printed before the adjournment of the legislature, it is thought best by the board to revise the copy and bring it down to the date of issue, July 1, 1895; therefore this report covers practically a period of eighteen months. In accordance with a change in the law the reports of this board will hereafter be issued biennially instead of annually.

The experience of more than a decade has fully convinced the board that the position which it has always taken with reference to the character of the reports has accomplished more in the line of sanitary knowledge and advancement among the people of the state than could have been attained had the reports been devoted more to scientific investigations and technical sanitation. We have therefore endeavored to make our reports, or at least considerable portions of them, readable for the masses, and the large demand made by our citizens for these volumes indicates that they are highly appreciated. Three thousand copies are issued annually, but the call for them has exhausted the reports of certain years so that now it is impossible for the board to furnish a complete set.

SANITARY PROGRESS.

Great progress has been made in sanitary matters in this state in a few years, and never has there been a time when the importance of sanitation was so well understood by the people as now. The public realize that good health and longevity are dependent in a very great measure upon the environments of the family. The maintenance of health and the attainment of a ripe old age depend upon certain favorable factors without which these desirable ends

cannot be reached. Sanitary knowledge distinguishes these influences and thus guards against many of the conditions that impair the health and prematurely destroy life. The evidence of the progress made in the direction indicated is shown in the greater attention now given to the subject of public and private water supplies; sewerage and drainage; ventilation of school-houses, factories, halls, and private residences; isolation of infectious and contagious diseases; the regulation of offensive trades; and the avoidance of many other conditions and habits detrimental to health and comfort.

ELECTION OF HEALTH OFFICERS.

In the last annual report of this board, we commented at some length upon the necessity of a more efficient local health service, and recommended that the legislature make provisions for the election of one member of a local board of health annually, so that at no time would the board be constituted of men with no experience as health officers, as is very frequently the case under the present law.

This subject was carefully considered in a bill which came before the committee on public health of the house, and was unanimously recommended by that committee, and passed by the house in the following shape:

AN ACT to Increase the Efficiency of Local Boards of Health.

Be it enacted by the Senate and House of Representatives in General Court convened:

SECTION 1. The selectmen of each town shall, within thirty days after the passage of this act, appoint a board of health which shall consist of three persons, selected with reference to their fitness for the office, and they shall be so appointed that the term of office of one member shall expire each year, and the members thereafter appointed shall hold office three years, and until their successors are appointed and qualified. In case a vacancy occurs in the board, the selectmen shall appoint a person to fill the unexpired term.

SECT. 2. When a board of health has been appointed and qualified in accordance with section 1 of this act, the previously existing board of health shall be discontinued.

SECT. 3. Chapter 43 of the Public Statutes is hereby amended by striking out the words "health officers" in section 25, and the words "or health officers" in section 40 of said chapter. This act shall not

apply to cities or to precincts in which health officers are provided for by special act of the legislature.

SECT. 4. All acts and parts of acts inconsistent with this act are hereby repealed, and this act shall take effect upon its passage.

This bill was killed by the senate committee without a hearing, therefore no legislation was secured at the session of 1895 for increasing the efficiency of local boards of health.

It is to be regretted that legislative committees sometimes assume to have greater knowledge in a certain line than a department which is engaged exclusively in the work. We commend this bill to the next legislature, and assert that it is in the line of progress and necessary to secure better sanitary work in many of the towns in the state.

The experience of the last town elections most emphatically corroborates the position taken by this board with reference to the election of health officers. Immediately after the election, this board received numerous communications somewhat like this:

APRIL 2, 1895.

State Board of Health:

GENTLEMEN,—The board of health elected at the last town-meeting has had a meeting, and I have been elected secretary of it. None of us know anything about the business. Send information. The old board has turned over nothing to us; if we have any use for blanks, etc., send them.

Yours truly,

——— ———, *Secretary.*

It is not an exaggeration to say that the board received many letters which are similar to the above. By the time such a board of health has sufficient sanitary knowledge to do a little good work for the town, it is superseded by another board elected in precisely the same manner; hence a town may not, for a series of years, possess a competent board of health.

It is very gratifying to be able to say that this is not true of all towns in the state. If it were, our local health service would be of a most incompetent character. On the other hand, a majority of the towns and cities possess competent health officers who are doing most excellent and valuable work for their localities.

The great sanitary progress which has been made in this state in a very few years is due largely to the work of the local boards of

health, many of which have been instructed and materially assisted by the state board; but we maintain that every town and city in the state should have an efficient health officer, or local board of health, and such a desideratum cannot be acquired if biennial rotation in office is to be followed.

A health officer requires a large amount of knowledge, much of which is of a special and exact character, and which can only be acquired by both experience and study. Therefore, if a town is to have good health service, it should, in the first place, choose able and intelligent men, and then continue them in office so long as they will faithfully fill the position for which they have been selected.

ISOLATION OF CONTAGIOUS AND INFECTIOUS DISEASES.

The regulations requiring the isolation of contagious and infectious diseases, particularly scarlet fever and diphtheria, are now very generally enforced throughout the state. The public has become convinced that these diseases can be restricted by proper management, and the popular sentiment now supports local boards of health in maintaining the necessary isolation, carrying out disinfection, and employing such other means as may be necessary to prevent the spread of these diseases.

The utility of placarding an infected house, isolating as far as may be necessary the patient and attendants, and disinfecting the premises at the proper time is not now questioned in any community, and this kind of work has saved to New Hampshire many valuable lives.

The majority of our towns take prompt action upon the outbreak of these diseases; and have accomplished a great work in the prevention of their spread. We have noticed that in certain towns, which might be named, that scarlet fever, seldom, if ever, gets beyond the first house infected, so efficient is the work of the local board of health. We are convinced that if this kind of executive work was maintained in all of the towns in the state a still greater saving of life would be the result.

SMALL-POX.

The recent outbreak of small-pox in this state and its speedy suppression, exemplifies what can be done in the management of

this disease under modern methods of sanitary administration. A record of the outbreak will be found elsewhere in this report. The fact that the disease had existed for over a month before it was known to the local health authorities; that a great number of persons were exposed; that thirty-eight contracted the disease, and the outbreak was completely suppressed and the state rid of the disease in nine weeks from the time of its discovery, is a sufficient comment upon the methods resorted to for its suppression.

The value of vaccination was most emphatically demonstrated in this outbreak, and but for this protective measure a large epidemic could not have been avoided under the circumstances. Not only was the protective power of vaccination most fully demonstrated, but its power to modify the disease was also clearly shown.

This outbreak is the first of any magnitude that has appeared in this state for nearly twenty years; and it serves to demonstrate how insidiously the disease may at any time be brought into a community. In many localities in this state it would not be so easy a matter to suppress it. If it had appeared under like circumstances in some of our large manufacturing centers, the results might have been much more lamentable.

This outbreak should serve to show the local health authorities that they are at any time liable to have this disease to deal with, and it should also demonstrate to the people at large that vaccination is the only protection against the disease, and that it is the duty of every citizen to be vaccinated.

PUBLIC WATER SUPPLIES.

The board has in contemplation the sanitary examination of the public water supplies of the state, and to that end has commenced the necessary preliminary work. There is no subject more vitally connected with the public health interests of a community than its water supply, and it is the purpose of this board to eventually complete a series of examinations that will be of great value to the state. The only obstacle in the way of rapidly carrying on this work is the lack of specific appropriation for the purpose, we are, however, able to do a little work from year to year, the aggregate of which will be of public importance.

We have, since the organization of the board in 1881, devoted a great deal of time and attention to the matter of public and

private water supplies, and the influence which has been exerted both in an official capacity with local authorities, and in the dissemination of information upon the dangers of water pollution, has resulted in a great improvement in the water supplies of many of our towns. Hundreds of polluted surface wells have been abandoned, and water from an uncontaminated and reliable source has been taken instead. The people of the state have to-day a far more exact knowledge of the dangers that come from a contaminated water supply than they possessed even a decade ago. The fact that typhoid fever is more generally communicated and spread through a water supply than by any other means is now a matter of public information. Likewise it is also known that unwholesome water is the cause of many other ills, and that in order to secure a good quality of potable water, it is necessary to have some knowledge of the conditions which effect the purity of the water supply.

Some of the former reports of this board contain a large amount of information upon these points. The work will be continued by this board in the systematic manner indicated as far as circumstances will allow.

FIRE ESCAPES AT SUMMER RESORT HOTELS.

The board has for many years given especial attention to the sanitation of our summer resort hotels, boarding-houses, etc., believing that the summer visitor is entitled to the greatest protection that can be given him by the state. To this end the board has from time to time caused many sanitary inspections to be made in those localities frequented by the summer visitor, and made many suggestions which have been carried out by the proprietors of summer resort hotels and boarding-houses.

At the present time the board is seeking specific information in relation to fire escapes at this class of hotels. A circular letter, accompanied with a blank, has been sent to the proprietors and managers of all, or nearly all, of the summer resort houses in the state, asking for a detailed report upon the means of escape in case of a fire, the facilities for putting out fire, the source of water supply, the drainage, and other particulars bearing upon the sanitary condition of the place.

Complete replies have not yet been received from all, therefore

a report cannot be made at present upon the individual summer resort hotels. We may say, in a general way, that we find that provision has been made for escape in case of fire in a large majority of the hotels and boarding-houses; that there are some who have not given the matter sufficient attention. The latter class will be asked to make such provisions as may be necessary to fully protect their guests in case of a conflagration.

COMMISSIONERS OF LUNACY.

The State Board of Health constitutes also a State Board of Commissioners of Lunacy. The board has supervision over the indigent insane, with authority to transfer any person of this class that it may deem best to the New Hampshire Asylum for the Insane for remedial treatment.

Since the organization of this commission five years ago, up to September 30 last the board had committed to the state asylum for remedial treatment 279 patients.

Of the number committed and discharged during the past year, there were over 13 per cent. of recoveries and an equal number improved.

The total number of insane persons at the different institutions of the state are given in the following table:

NAMES OF INSTITUTIONS.	Inmates Oct. 1, 1894.
New Hampshire Asylum for the Insane	404
Rockingham County Asylum	55
Strafford County Asylum	.....
Belknap County Almshouse	8
Carroll County Asylum	14
Merrimack County Asylum	43
Hillsborough County Asylum	86
Cheshire County Asylum	24
Sullivan County Asylum	13
Grafton County Asylum	21
Coös County Asylum	16
Total for state	684

The law which allows the board to transfer certain indigent persons to the state asylum for remedial treatment is one of the most munificent and humane that has ever been enacted by the state. The benefits which have already accrued from this law cannot be computed upon a money basis.

CORRESPONDENCE.

The correspondence of the board is large and requires no little time and attention to give it due consideration. Many questions of more or less magnitude are submitted by local boards of health upon points of law, methods of procedure upon the abatement of nuisances, methods of isolation in contagious and infectious diseases, and many other things relating to the executive work of local health authorities.

A large amount of correspondence is also necessary in many instances in instructing new local boards of health in the duties that devolve upon them.

In addition to the official correspondence alluded to, hundreds of letters are annually received from private individuals asking for specific information upon sanitary matters—how to sewer premises; trap a fixture; make a cess pool; construct a sink drain; get rid of an offensive condition maintained by a neighbor; when measles, scarlet fever, and diphtheria are contagious; when they are not; when children can be sent to school after having had these diseases; how to test their water supply; where to dig a new well, and a thousand-and-one questions, all seeking for information for the better protection of the family against the dangers which come from unsanitary conditions and environments.

In no case is a letter ignored or fails to receive an answer unless it is anonymous. Believing that one of the chief functions of a state board of health is to educate the people in sanitary matters, we have made it a point to give careful consideration to all correspondents making inquiries for sanitary knowledge.

REGISTRATION OF VITAL STATISTICS.

The Board continues to have charge of the registration of births, marriages, divorces and deaths, and has recently issued the thirteenth annual report. For several years these reports have constituted an annual volume of nearly 300 pages, composed mostly of

statistical tables from which, after a serious of years, most valuable facts and conclusions may be deduced relating to the movement of the population, and particularly concerning causes of death, as well as indicating localities in which sanitary work is necessary in order to decrease an abnormally large death rate. The value of these statistics in many directions cannot be estimated from the reports of a single year. It is only after the tables referred to have covered a serious of years that their greatest usefulness is attained.

The registration of births is incomplete, although a better return is now made than ever before. The records of marriages and death may be considered correct, or as nearly so as is possible to attain under any system of registration.

The last legislature made a change in the law relating to the issuing of burial permits in the cities of the states, so that at the present time the return is made to the board of health instead of the city clerk, and the burial permit issued by the board. All the facts, however, are transmitted to the city clerk for record. The object of this law is to secure a more correct return of the causes of death in our cities, and to more readily detect any false statement that may be made in connection therewith, and also, if necessary, to investigate the alleged cause of death.

Arrangements are now being made for filing all the records of vital statistics returned to this office, in a fire proof room in the State Library Building. These records have become quite voluminous and of very great importance, since, in many instances, they are the only legal records in existence of the individuals to whom they refer.

THE SECRETARY'S REPORT.

Under this heading in the following pages are included, several papers and reports by the Secretary, as well as some valuable contributions and selected articles relating to public sanitation.

We submit these reports and papers for the purpose of giving the people of New Hampshire, a more extended knowledge in certain branches of sanitary science.

SECRETARY'S REPORT.

TUBERCULOSIS.

An unusual interest is being taken in tuberculosis, because it has been proven that pulmonary consumption in the human family and tuberculosis in animals are precisely the same disease, and that this disease is a communicable one as it is also largely, if not wholly, a preventable one.

Tuberculosis, which is more frequently called consumption, is the most fatal disease known to mankind. It is, perhaps, more widely spread over the civilized areas of the globe than any other malady. Its entire career is so insidious and deceptive that the public mind is never awakened to the enormity of the disease, and so, without excitement, and heretofore without any attempt towards its restriction, it has been allowed to silently pursue its way, slaughtering its thousands and tens of thousands, annually. The last census of the United States shows that there are in this country over 100,000 deaths annually from this disease, a number far in excess of that reached by any other cause of mortality.

Our own state is by no means a favored one. Indeed, it is true that the eastern portion of this country, including the New England states, has a high mortality from consumption. The death records in this state for the past ten years, from 1883 to 1893, inclusive, show 8,510 deaths from pulmonary tuberculosis during that period. The total mortality for the same

period was 75,503, which, compared with the death rate from consumption, shows that a little less than every ninth death was caused by that disease. If to the figures already given were added deaths from other tuberculous causes, it is quite probable that it would show an annual death rate from this disease in New Hampshire approximating 1,000 persons. These figures are given in the briefest possible manner in order to present an idea of the extent of the disease under consideration. Very few people realize the widespread character and the terrible mortality that accompanies tuberculosis. All the deaths which occur in the state from other contagious and infectious diseases added together would not equal the number caused by consumption.

A diagram showing the more prominent causes of deaths in this state for the past nine years gives a graphic view of the relative importance of consumption among twelve of the most fatal diseases which we have.

A single case of smallpox alarms a whole community, while a few cases are enough to interfere with business, and even cause some people to leave the infected community; yet, we have had but four deaths from smallpox in New Hampshire in a decade.

Scarlet fever, which frightens the public upon its appearance, has, by means of isolation and disinfection, been reduced to an annual average of twenty-five deaths for the period named.

Diphtheria, one of the frightful diseases with which we are still too often called upon to meet, stands at the foot of this list.

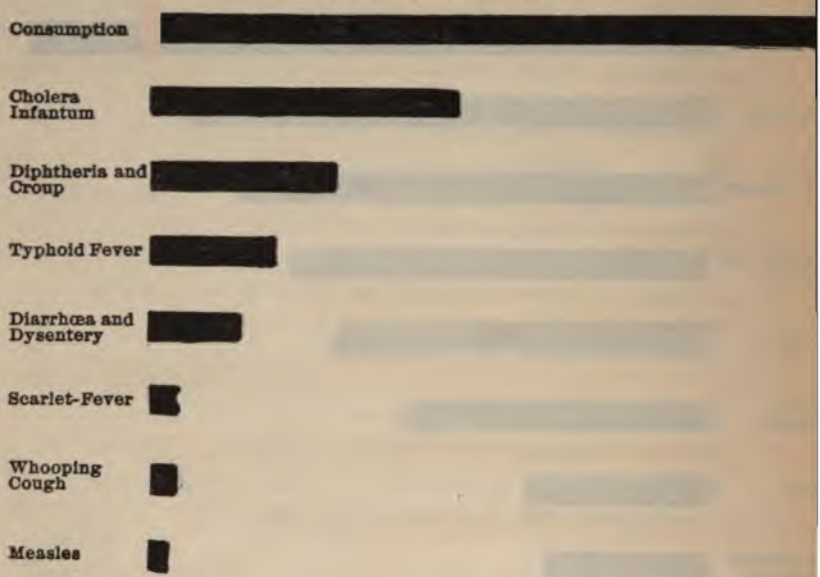
Typhoid fever, which through sanitary work has been greatly reduced in recent years, is the next in order; and so we go up the list till we reach the long, black line at the top which represents consumption, a controllable disease uncontrolled.

Diagram No. 1,

ng the relative mortality in New Hampshire from twelve of the most prominent causes, from 1884 to 1892, inclusive.

Diagram No. 2,

Showing the relative mortality from the leading preventable diseases in N Hampshire, from 1884 to 1892, inclusive.



The relation which the leading communicable and preventable diseases bear to each other is represented in diagram No. 2. It commences with measles, and is followed by whooping cough, scarlet fever, diarrhœa and dysentery, typhoid fever, diphtheria and croup, cholera infantum and consumption.

We present these diagrams to give a better and more logical idea of the relations which these diseases bear to each other as represented by the actual death rate of the state. These diagrams are drawn to a scale so that a proportionate relation of the diseases named is accurately represented.

Diagram No. 3.

Diagram showing percentages of deaths from consumption, from 1883 to 1893 inclusive, to the total living population of the same age period.

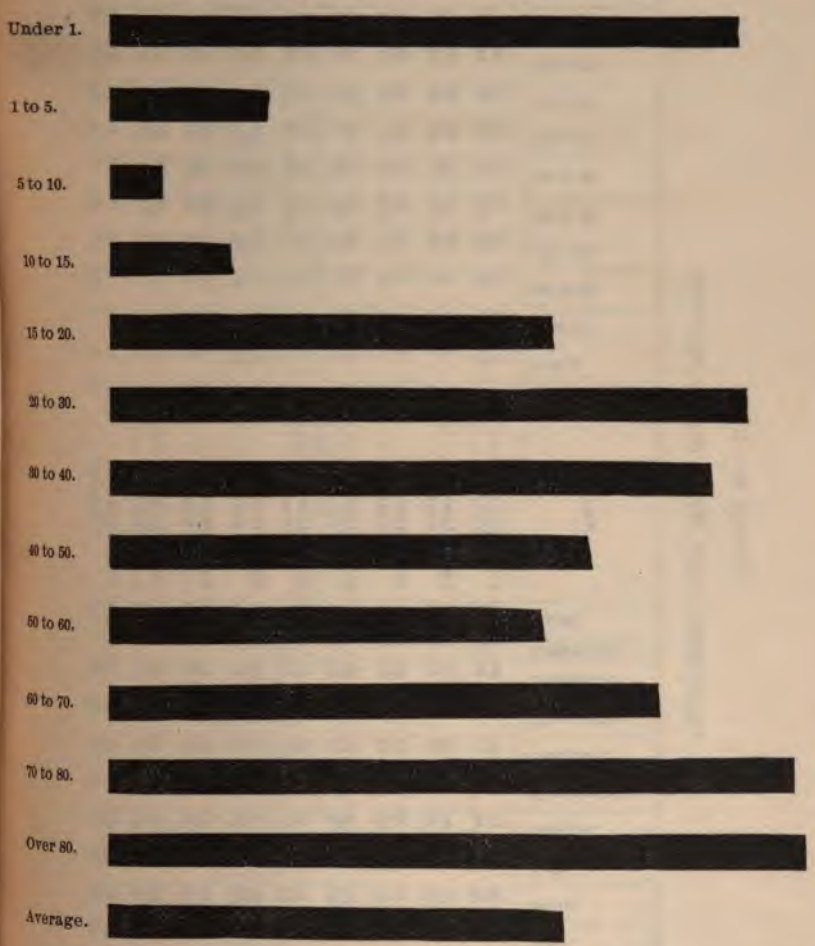


Diagram No. 3 presents the percentages of deaths from consumption in a most forcible manner. These rates are calculated upon the living of the same age groups as compiled from the census of 1880 and 1890, and therefore must be approximately correct.

TABLE No. 1.

Consumption.—Age, Month, and Sex, by Years.

	Sex.	Under 1.	1 to 5.	5 to 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Unknown.	Total.
January.	1883—Males.....	....	16	2	2	26	72	52	44	29	36	26	7	13	325
	Females.....	....	14	3	22	53	153	84	44	33	34	38	12	12	502
	1884—Males.....	7	5	4	6	26	95	54	40	35	29	36	7	11	355
	Females.....	9	7	6	15	68	137	94	56	36	32	28	15	10	513
	1885—Males.....	19	8	1	2	34	84	67	50	43	38	20	8	3	377
	Females.....	12	6	3	10	57	134	92	57	33	37	22	11	6	480
	1886—Males.....	10	12	3	3	23	95	70	50	33	41	14	10	3	367
	Females.....	3	12	4	8	53	138	82	41	34	33	23	8	3	442
	1887—Males.....	11	3	....	6	22	74	55	46	45	26	17	8	3	316
	Females.....	4	9	7	9	51	117	90	55	33	28	29	13	2	447
	1888—Males.....	9	10	1	9	18	87	88	28	38	22	23	7	5	315
	Females.....	15	10	3	10	51	132	79	43	24	33	19	8	....	427
	1889—Males.....	9	7	3	3	22	56	51	33	34	31	26	2	4	281
	Females.....	5	8	4	19	37	91	69	44	22	34	27	8	2	370
	1890—Males.....	13	6	3	5	17	83	74	57	41	38	31	12	2	382
	Females.....	12	11	4	11	44	117	82	56	24	34	32	11	5	443
	1891—Males.....	11	10	2	5	23	78	60	46	36	16	15	4	5	311
	Females.....	8	9	7	12	47	96	71	43	31	21	28	6	6	384

| | | |

The great mortality in children under one year old is most forcibly illustrated by the first line in diagram 3. Following this up to fifteen years of age there is a marked exemption from the disease. From the latter age to the extreme of life the variation is not so great and the mortality is large, as will readily be seen. These figures most forcibly controvert an opinion which is somewhat general among people, to wit: that the greatest fatality occurred in persons between twenty and forty years of age. While it is true that there are a greater number of deaths during that period of life, because there are a greater number of living persons of the same age, it is not true that it is relatively the most fatal period of existence. On the other hand it is true that the greatest mortality from consumption occurs in persons over seventy years of age. It is not necessary to elaborate upon the figures which are shown in table 1 and illustrations in diagram No. 3, for they are in themselves the strongest kind of evidence.

Table No. 1 represents the deaths in New Hampshire from consumption by age, month, and sex, from 1883 to 1893 inclusive.

This table represents an interesting study of the ravages of this disease in many ways. It will be seen in studying the mortality by months that the variation is not great, and that seasons have very little to do with the mortality of this disease.

Under ages the statistics are still more interesting. The percentage of deaths by age groups to the living of the same ages is shown at the bottom of the table.

The foregoing diagrams and table are given solely for the purpose of impressing upon the people of the state the alarming magnitude of this disease with its various phases so far as it relates to age and sex.

The Vermont Agricultural Experiment station, in July last, issued a bulletin on Bovine Tuberculosis, in which the whole subject is so well presented that we quote extensively from it as follows:

GENERAL DISCUSSION OF THE DISEASE.

Tuberculosis is the general name for a class of diseases, of which consumption in the human family is a common type. It is variously named* according to its location in the body and the character of its host. It attacks man, the domestic animals, and sometimes wild beasts (particularly if in captivity). Among domesticated animals, cattle, fowl, and swine more readily contract the disease than horses, sheep, dogs, or cats. The latter easily succumb, however, if inoculated either intentionally or accidentally. There is no animal known to be proof against the disease.

I. PREVALENCE AND HISTORY.

Human. The ravages of tuberculosis in the human family are far greater than are those of any other disease. The death rate from consumption, which is but one of its many forms, is about one in seven. In all its forms it is said to contribute to the death of one in every four, and the records of human post-mortems indicate that one in two has had the disease and either died of it or had its progress arrested.

When conditions have favored its spread, the death rate from tuberculosis has been as high as 50 per cent. of all mortalities. Many of the fatal bowel troubles of infants have their origin in tubercular infection. An article in the Archives de Medicine says that "of the population of the globe, three millions die annually of consumption." It has been well said that, "if the 5,490 deaths from tuberculosis which occur every year in the city of New York could be brought together in an epidemic lasting but one week, no smallpox, cholera, or yellow fever scare would approach the panic which would be thus created, . . . if we take the whole civilized world and compare with the tuberculosis mortality, all the accumu-

*Some of the more common names are: *Human; Lung;* consumption, pulmonary consumption, tuberculosis, consumption, phthisis, pulmonary phthisis, tubercular phthisis, pulmonary ulceration, quick or galloping consumption (acute miliary tuberculosis), old fashioned consumption (chronic tuberculosis;) *Bowels;* consumption of the bowels, many forms of chronic diarrhœa, cholera infantum and cholera morbus; *Nervous System and Brain;* tubercular meningitis, acute hydrocephalus; *Skin;* anatomical tubercle, lupus and scrofuloderma; *Bone and Joints;* hip-joint disease, white swelling of the knee; *Glands;* tubercular adenitis: *Abdominal Cavity;* tubercular peritonitis; tubercular nephritis; *Animal;* same as in human, together with pining, wasting of the lungs, knots, kernels, grapes, angleberries, bovine tuberculosis, pearl disease, pearlsucht, also some forms of nymphomania, satyriasis, etc.

The great mortality in children under one year old is most forcibly illustrated by the first line in diagram 3. Following this up to fifteen years of age there is a marked exemption from the disease. From the latter age to the extreme of life the variation is not so great and the mortality is large, as will readily be seen. These figures most forcibly controvert an opinion which is somewhat general among people, to wit: that the greatest fatality occurred in persons between twenty and forty years of age. While it is true that there are a greater number of deaths during that period of life, because there are a greater number of living persons of the same age, it is not true that it is relatively the most fatal period of existence. On the other hand it is true that the greatest mortality from consumption occurs in persons over seventy years of age. It is not necessary to elaborate upon the figures which are shown in table 1 and illustrations in diagram No. 3, for they are in themselves the strongest kind of evidence.

Table No. 1 represents the deaths in New Hampshire from consumption by age, month, and sex, from 1883 to 1893 inclusive.

This table represents an interesting study of the ravages of this disease in many ways. It will be seen in studying the mortality by months that the variation is not great, and that seasons have very little to do with the mortality of this disease.

Under ages the statistics are still more interesting. The percentage of deaths by age groups to the living of the same ages is shown at the bottom of the table.

The foregoing diagrams and table are given solely for the purpose of impressing upon the people of the state the alarming magnitude of this disease with its various phases so far as it relates to age and sex.

The Vermont Agricultural Experiment station, in July last, issued a bulletin on Bovine Tuberculosis, in which the whole subject is so well presented that we quote extensively from it as follows:

GENERAL DISCUSSION OF THE DISEASE.

Tuberculosis is the general name for a class of diseases, of which consumption in the human family is a common type. It is variously named* according to its location in the body and the character of its host. It attacks man, the domestic animals, and sometimes wild beasts (particularly if in captivity). Among domesticated animals, cattle, fowl, and swine more readily contract the disease than horses, sheep, dogs, or cats. The latter easily succumb, however, if inoculated either intentionally or accidentally. There is no animal known to be proof against the disease.

I. PREVALENCE AND HISTORY.

Human. The ravages of tuberculosis in the human family are far greater than are those of any other disease. The death rate from consumption, which is but one of its many forms, is about one in seven. In all its forms it is said to contribute to the death of one in every four, and the records of human post-mortems indicate that one in two has had the disease and either died of it or had its progress arrested.

When conditions have favored its spread, the death rate from tuberculosis has been as high as 50 per cent. of all mortalities. Many of the fatal bowel troubles of infants have their origin in tubercular infection. An article in the Archives de Medicine says that "of the population of the globe, three millions die annually of consumption." It has been well said that, "if the 5,490 deaths from tuberculosis which occur every year in the city of New York could be brought together in an epidemic lasting but one week, no smallpox, cholera, or yellow fever scare would approach the panic which would be thus created, . . . if we take the whole civilized world and compare with the tuberculosis mortality, all the accumu-

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lated deaths from war, famine, plague, cholera, yellow fever, and smallpox, the latter are comparatively very insignificant." *

Bovine. The lack of systematic professional inspection of live and slaughtered animals, as well as the actual variations in the extent of the disease in different localities, gives us somewhat contradictory data regarding the prevalence of bovine tuberculosis.

Probably many of the estimates given by various authors are based on faulty or insufficient data. The following examples may serve to some extent to indicate its prevalence. The extremes are wide, being from 0.02 per cent. (among 2,273,547 cattle, mostly steers, killed in the meat inspection districts of the United States from May 15, 1891, to March 1, 1892,† to 60 to 70 per cent. at Hildesheim, Hanover, according to Haarstick). In a large number of German abattoirs it is stated that 6.9 per cent. of the cows, 3.6 per cent. of the steers, 2.6 per cent. of the bulls, and 1 per cent. of the young stock were tuberculous‡. Of 1,270,604 animals slaughtered in German abattoirs from October, 1888, to October, 1889, 26,352 or 2 per cent. were tuberculous§. Careful post-mortems by skilled veterinarians showed 12 per cent. of tuberculous animals out of 12,000 slaughtered in England as affected or exposed to contagious pleura pneumonia (a disease entirely distinct from tuberculosis) ‖. In seventeen counties in New York state the inspectors of the state board of health found 3.4 per cent. tuberculous cattle out of 20,000 inspected¶. Cattle slaughtered at Baltimore were found tuberculous to the extent of from 2.5 to 3.5 per cent.* while of 1,153 cattle from the Eastern states (mainly New England) slaughtered at Brighton, Massachusetts, 52 or 4.5 per cent. were tuberculous†. Salmon and Smith state that "it is not far from the truth to assume . . . that one of every fifty head of cattle in the more densely populated areas of Europe and America is tuberculous"‡. Dr. Salmon states yet later, however, that "the

* Law. Cornell University Experiment Station, Bul. No. 65, p. 105.

† Salmon and Smith, Special Report on Diseases of Cattle, etc., Bureau of Animal Industry, United States Department of Agriculture, 1892, p. 399.

‡ Reported by Law. *Ibid.* p. 107.

§ Report of Imperial Health Office, Berlin. Vol. 7.

‖ Annual report for 1892 of Dr. G. T. Brown, Director of Veterinary Department of the Board of Agriculture of Great Britain.

¶ Country Gentleman, January 18, 1894.

* Sixth and Seventh Reports Bureau of Animal Industry, p. 51.

† Boston Board of Health. Report of Dr. Alex Burr, Inspector, etc., for 1890.

‡ Salmon and Smith, *Ibid* p. 399.

ideas in regard to the prevalence of tuberculosis have been radically changed by the facts brought out in using tuberculin*."

The fine showing of the Western abattoirs is mainly due to the fact that the beeves killed there are grown out of doors, are slaughtered while still young, and because as a rule only healthy animals are shipped to and accepted by them. On the other hand, Eastern and foreign abattoirs more often deal with stall-fed animals and with old cows, in both of which the proportion of disease is higher.

History.

Tuberculosis is no new disease. Both the human and bovine forms have been known for many centuries, under a great many different names. Four hundred years before Christ, Hippocrates† described the abcesses and ulcers of the lungs, which characterize the disease of to-day. As early as the Middle Ages, the animal type of the disease was considered contagious and the flesh discarded. Various theories regarding its cause have been advocated and shown untenable. Until recently the theory of heredity was considered most probable, but it is now definitely proved that its true cause is bacterial.

II. ESSENTIAL OR EXCITING CAUSE.—THE BACILLUS TUBERCULOSIS.

Although infection by inhalation (breathing), by inoculation (through wounds, etc.), and by feeding was definitely proved by Villemin ‡ in 1865, and later by Cohnheim §, Toussaint‖ and many others, the true cause of the infectiousness of tuberculous matter was not found until 1882. On March 24th of that year, Dr. Robert Koch of Berlin, Germany, read a paper before the Physiological Society of that city, in which he announced the discovery of the germ causing the disease ¶. He named this germ *Bacillus tuberculosis*. The most painstaking care was used in verifying the facts before they were given to the world. Koch demonstrated the presence of the germ in the sputa (spittle) or tubercle (a round,

* Breeders' Gazette, Chicago, June 14, 1893.

† Littre's edit. of Hippocrates. V. p. 675, VI. p. 173, VII. p. 73.

‡ Etude sur la Tuberculose.

§ Ubertragbarkeit d. Tuberculose, Berlin, 1877.

‖ Compt. Rend. XCIII.

¶ Berliner Klin. Wochenschrift, XV, 1882; also Mittheil aus dem Kaiserlich-gesundheitsamte, "Aetiologie der Tuberculose."

nodular mass of diseased matter, small or large, characteristic of tuberculosis), of over a hundred cases of consumption, and successfully inoculated nearly five hundred lower animals, producing in them the same disease. The concluding sentence of his paper has yet to be disproved: "We can with good reason say that the tubercle bacillus is not simply one cause of tuberculosis, but its sole cause, and that without tubercle bacilli you would have no tuberculosis."*

*It may not be out of place to define bacteria and to describe briefly the present status of the germ theory of disease. All matter, soil, air, water, and living beings, vegetable and animal, is pervaded with many forms of minute vegetable life. They belong to several more or less distinct classes or families, but, on account of their microscopic size, they are usually grouped under one name, micro-organisms. Bacteria, fungi, moulds, yeasts, etc., are types of this low order of plant life.

Bacteria (also called microbes and germs) are microscopic plants consisting of single cells or sacs, containing protoplasm (the vital substance by which the process of nutrition, secretion and growth go forward) reproducing by division and by the production of single spores (a small grain analogous to seed in flowering plants.) Many are capable of motion. They are at present provisionally divided into groups (genera) based mainly upon their form. The principal groups are the globe-shaped bacteria (micrococcus), the rod-shaped bacteria (bacillus), and the spiral or cork-screw-shaped bacteria (spirillum). Each of these has many hundreds of species. Each originates only in a germ of its own species, and is never spontaneously generated. Warmth, moisture, and organic matter favor bacterial growth. Some species are readily destroyed, others, particularly in the spore form, are very resistant even to extreme degrees of heat or cold. Sunlight, air (in time), the temperature of boiling water, and certain chemicals are generally destructive to germ life. Fungi, moulds, and yeasts differ from bacteria mainly in their methods of reproduction. Many of the common operations of daily life, such as the raising of bread (in part), the souring of milk, the ripening of butter and cheese, the making of vinegar and the nitrifying of organic matter in the soil, are due to bacterial action.

Disease also is often the result of the growth of bacteria in the bodily tissues. The pathogenic (disease producing) bacteria are mainly micrococci and bacilli. The casual relation of micro-organisms to disease is proved by the series of tests usually called "the four postulates of Koch:"

1. "The germs must be found in the blood lymph or diseased tissues of man or animal suffering from or dead of the disease.

2. "The germs must be isolated from the blood lymph or tissue and cultivated in suitable media outside the animal body. These pure cultures must be carried on through successive generations of the organism.

3. "A pure cultivation thus obtained must, when introduced into the body of a healthy animal, produce the disease in question.

4. "In the inoculated animal the same germs must be found again."

This chain of evidence has shown that the causes of most contagious diseases are bacterial.

The germ theory of disease is that these minute plants grow in the body, that the products of their growth are poisonous, and that a definite disease is due to the effects of the poisons produced by a definite species of germ.

This germ (bacillus tuberculosis) is a parasitic, vegetable microorganism, which under the microscope is seen to be a minute rod with rounded ends, usually slightly curved. It is about ten times as long as it is broad, and measures on the average about one ten-thousandth of an inch in length. It occurs singly, in pairs, or in chains of from three to six. It probably does not reproduce itself by spores. This germ lives in the animal body and thrives best at a little above the normal temperature of the human body. It has great vitality, resisting heat, cold, moisture, drought, decay, and often the process of digestion. Its virulence is not lessened by drying at temperatures below 150° F. A short exposure at 212° F. or a longer continued heating at from 160 to 170° F. is sufficient to kill the germ. These temperatures are not always attained in the interior of a piece of cooking-meat, and a rare steak or roast, if from a tuberculous animal, may contain live germs capable of causing the disease in the person eating the meat. Milk may be used with safety, if heated for an hour at about 160° F. A higher temperature would be desirable, but it coagulates the albumen, gives the milk a boiled taste, lessens the digestibility, and increases its tendency to constipate.

The tubercle bacillus has lived for many weeks in ice and been found virulent on thawing. Since moisture and decay do not affect it, wells, drinking troughs, and burial grounds (human and animal), in short, wherever tuberculous matter has been exposed or placed, are all liable to be infected. The germ has been found in earth worms which had fed on tuberculous tissue, and it is evident that they may be factors in the spread of disease in bringing buried tuberculous matter to the surface.

Sources of Infection.

There are three methods of infection :—

1. By inhalation (breathing the germs into the lungs).

2. By ingestion (swallowing the germs).

3. By inoculation (the entrance of the germ by some channel other than the lungs or stomach, as, for instance, through a cut or wound).

There are three general sources of infection :—

1. The dust of the dried sputa of consumptives or other tuberculous matter, either inhaled or swallowed.

2. Contact with the tuberculous material of those suffering from the disease, thus becoming infected either by inhalation, ingestion, or inoculation. (For example, in kissing a tuberculous person there might be danger of either ingestion or of inoculation with the tuberculous sputa).

3. The meat and milk of tuberculous animals. (The third source of infection is considered at length elsewhere in this report.)

The sputa of consumptives containing tubercle bacilli is freely strewn around our streets and buildings. Since the virulence of the germ is not lessened by drying, dust is necessarily a common and omnipresent source of infection. The dust from our streets, stores, dwellings, and places of assembly, particularly where tuberculous people live or congregate, is infectious. The dried sputa from the handkerchiefs, the beds and bedrooms of consumptives, and the mangers of tuberculous cattle are particularly rich with the germs. This is the main source of infection to human beings, one to which everyone is exposed. It is not too much to hope that this danger will grow less when more general destruction or disinfection of sputa is observed.

If this infectious principle is all about us, why does not every one die of tuberculosis? Many do thus die. As already noted the death rate from but one form of the disease is one in seven, and from all forms, nearly one in four.

Yet on the other hand we have powerful allies in pure air and sunlight. The harmless germs greatly out-number those that produce disease, the war between the various species is one of extermination, and myriads of the disease-producing germs are thus destroyed. There are, moreover, natural forces in the body which are antagonistic to germ life. They are the real causes of immunity (the natural organized powers of bodily resistance to the attack of disease) against contagious diseases. There are three main theories explaining this matter. Metschnikoff* claims that the tissue-cells of the body, particularly the white blood corpuscles, attack and destroy micro-organisms and that in them the animal body possesses a formidable means of resistance and defense against these infectious agents. Buchner† and others consider that the

*Lecture to Institut Pasteur, Dec. 29, 1890.

†Eine neue theorie über Erzielung. Immunität gegen Infectionskrankheiten Munich, 1883.

blood serum and tissue juices have germicidal properties. On the other hand, Lister* claims for the bodily tissues a certain standard of vitality by which they are able to ward off the attack of disease-producing germs. While this standard is maintained the attack is in vain, but when the infection and reduced vitality occur together there is chance for disease. The germicidal action of healthy gastric juice is universally admitted. Immunity against recurring attacks of the same contagious disease is explained in two ways, one by the exhaustion of the peculiar food of the specific germ in the first attack, the other by the existence in the body of sufficient quantities of the self-made germ poison to kill all new comers of the same species.

III. ACCESSORY OR PREDISPOSING CAUSES. CONDITIONS FAVORING THE DEVELOPMENT OF TUBERCULOSIS.

There are certain conditions of birth and modes of life which are potent factors in the spread of tuberculosis. The tubercle bacillus alone is its true exciting cause, but there are conditions so favorable to its development that they are well-termed "accessory causes," although strictly speaking they are not causal. The kernel of corn is the essential cause of the growth of the corn plant, and soil, moisture, and warmth are accessory causes furnishing conditions favoring its development. The kernel could only grow with great difficulty, if at all, without their help; but on the other hand, there could be no growth whatever, no matter how rich the soil or how favorable the season, unless the seed were planted. Similarly in disease the malady develops only when the germ is present, but the circumstances of individual cases, bodily conditions and surroundings, etc., are of the greatest importance in determining the result.

Among the conditions favoring the development of tuberculosis, if the tubercle bacillus is present, are:—

A. Hereditary predisposition.

B. Unhealthy surroundings; poor ventilation; uncleanly, dark, damp, hot and cold stabling; soiling system; lack of exercise; climatic influences.

C. Faulty feeding; under feeding; over feeding; feeding on unwholesome or indigestible materials; overproduction.

*Quart. Jour. Micr. Soc. London, 1881, n. s. XXI p. 330-342.

D. Faulty breeding ; in and in-breeding ; early, late, and frequent breeding ; intensive breeding ; lack of constitution.

E. Ill health. Temporary predisposition.

F. Physical conformation.

A. Hereditary Predisposition.

For many years consumption was considered a hereditary disease, transmitted from parent to offspring. It was said to run in families. It is now known to be but rarely hereditary, the proved cases of the infection of the fœtus in the womb being less than a dozen. There are on record but six cases of indubitable congenital tuberculosis in calves.*

It is not strange that this belief should have prevailed before the discovery of the germ. The well-known prevalence of tuberculosis in certain families is mainly due to two causes; first, to the concentration of the germs in the family home, and second, to a *lack of resistance, an inherited predisposition of this disease.* A person not thus susceptible may live uninfected in a family whose every member contracts the disease. All breathe the germ laden air, but the unfortunate family are a fruitful soil for its growth, while the stranger is not. Such facts are of common occurrence, and are best explained upon the ground of hereditary predisposition. This inherited tendency is found in cattle as well as in human beings. Dr. Law says: "In 1877 I recognized the existence of tuberculosis in the Jersey herd of Burton Bros., of Troy, N. Y. The worst were slaughtered, but some incipient cases in young animals were turned out in a pasture by themselves, where they passed the summer in apparently robust health, but they began to droop when they returned to the barn in the fall. I again visited the herd and picked out eleven diseased animals and had them killed, when Dr. James Burton informed me that I had destroyed every representative of a certain family, not even a grade having been left. From that time on there was no more trouble with tuberculosis in that Jersey herd."†

*Jour. Comp. Med. and Vet. Arch., Oct,, 1893, p. 240.

† Law, Tuberculosis in Animals, Report New Hampshire State Board of Agriculture, 1892, p. 16. Also reported in Cornell Univ. Expt. Sta. But. 65 p. 112.

B. Unhealthy Surroundings.

Imperfect ventilation has much to do with spreading infection. This is because of the repeated breathing of the same air, full of dust and germs, and because of the concentration of the bacteria within a small place. The lack of oxygen lowers the vital powers of animal or man and renders them less able to cope with the germs. An open air life prolongs the life of the consumptive. Tuberculous cattle which are unthrifty in the barn are often apt to pick up on pasture, and to run down again on returning to the barn in the fall (as in the case of the Burton herd cited above). Of 2,273,547 fat cattle inspected by the officers of the Bureau of Animal Industry at Western abattoirs, only 482 (.02 per cent.) were tuberculous, while out of 54,158 cows from city and country barns 669 (1.23 per cent.) were tuberculous.* There were fifty-seven tuberculous animals raised in confinement to one whose life had been spent out of doors. Other data, American and European, might be cited, showing the relatively high percentage of tuberculosis in stabled cows.

Dark, damp, and hot or cold stables are often partly responsible for the spread of tuberculosis. Light is a germicide, darkness a germ-preserver. Light favors the formation of the red corpuscles of the blood. When their numbers decrease, the offices of the blood, including its germicidal action, are impaired and the bodily vigor lessened. The effect is the same as if too little oxygen were inhaled, *i. e.*, equivalent to the effects of poor ventilation. Dampness favors colds, which, as is well known, are often the beginning of consumption. They make the soil more fertile for the growth of the seed. Hot stables make the animal tender and liable to catch cold. Cold stables, or turning out cattle in bitter weather, is apt to bring on colds, bronchitis, and pneumonia, which prepare the way for tuberculosis of the lungs.

Soiling cattle, their confinement with little or no exercise the year round makes unending the conditions already cited which otherwise last but half the year. Local circumstances sometimes compel this method of dairying, but cattle thus kept should be watched with great care for indications of disease.

*Salmon and Smith, *Ibid.*, p. 399.

Climate has its influence in spreading tuberculosis. A moist, changeable climate favors its development, while dry and rare air and uniform temperature tend to suppress it. The high table lands of the far western states afford relief to the human consumptive and possibly to the animal. Bovine tuberculosis is said to be unknown in those regions, and there are those who believe that in its earlier stages its course may be arrested by removal to high altitudes.

C. Faulty Feeding.

It is self-evident that underfeeding and the use of unwholesome or indigestible food lowers the vitality and hence the resistant powers of the animal. Overfeeding, either as gluttony or in the use of too rich a ration, or irregular feeding, are apt to cause indigestion and dyspepsia, thus predisposing to the disease. Heavy, stimulating feeds lead to over-production. The high production of milk and butter places the animal under a severe strain and tends to weaken her constitutional vigor and increases susceptibility.

D. Faulty Breeding.

*In and in-breeding** intensifies both good and bad traits. It concentrates desirable lines of personal and family character, but, unless carefully and intelligently managed, is liable to weaken constitution and conduce to disease. Line breeding, the most desirable type of in and in-breeding, is that by which our improved breeds of domestic animals were originated and perfected, and, when due regard is given to ancestral health and vigor, is often advantageous. Incestuous breeding, however, is to be condemned for it increases susceptibility, and often produces unsatisfactory results. Cattle thus inbred are proverbially liable to tuberculosis.

*In and in-breeding is usually considered to mean the pairing of close relations. Breeders differ as to degree of relationship covered by the term. It may mean only the coupling of animals of the precise same blood (brother and sister) or the frequent pairing of relations. Miles calls attention to the confusion of definitions, and says: "If the terms in-breeding, close breeding, and interbreeding are used to indicate the breeding together of closely related animals in a single instance, or at long repeated intervals, the term in and inbreeding could then be used with greater exactness to indicate the frequent repetition of the process." (Stock Breeding, p. 138.) For the present purpose the distinction may be drawn between incestuous breeding (brother and sister, parent and offspring, etc.,) and line breeding (within the limit of a family, and for a particular type of animal, generally without regard to relationship, not of necessity incestuously bred, but closely bred).

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When conditions have favored its spread, the death rate from tuberculosis has been as high as 50 per cent. of all mortalities. Many of the fatal bowel troubles of infants have their origin in tubercular infection. An article in the Archives de Medicine says that "of the population of the globe, three millions die annually of consumption." It has been well said that, "if the 5,490 deaths from tuberculosis which occur every year in the city of New York could be brought together in an epidemic lasting but one week, no smallpox, cholera, or yellow fever scare would approach the panic which would be thus created, . . . if we take the whole civilized world and compare with the tuberculosis mortality, all the accumu-

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juice, being acid, kills most germs, but an unhealthy stomach with weakened or diminished secretions offers less resistance to the passage of bacteria to the alkaline bowel where all the conditions are favorable to their growth and multiplication.

Temporary predispositions to tuberculosis occur in all individuals, human or animal. A hard cold, an overworked condition, or a fit of indigestion renders one temporarily much more open to infection than usual. Our bodies are continually at warfare with the germs. In health we conquer, but if the vitality be lowered we become for the time being susceptible. Since we cannot predict when infection and lowered vitality will coincide in ourselves or our animals, it is desirable to avoid both so far as possible.

F. Physical Conformation.

Cattle with narrow chests, light barrels, and long legs are, because of their build, apt to be predisposed to tuberculosis. Their circulation is generally poor, and they are apt to be poor feeders and unthrifty.

IV. SYMPTOMS OF BOVINE TUBERCULOSIS.

Tuberculosis in cattle sometimes assumes the acute form, but is usually of the chronic type, lasting for years. Mankind attacked by either form generally shows it by failing health. Cattle, on the contrary, seldom give external evidence that they have the disease until it is far advanced. The effects of the disease are too slight at first to materially interfere with the functions of the organs involved. The animals may and do live for years with decided tubercular lesions, and yet appear healthy, fattening readily and yielding large amounts of apparently normal milk. In the acute form, however, and in the last stage of the chronic, fever and wasting of the body occur. The marked difference in outward evidences of human and bovine tuberculosis lead many to doubt its existence in apparently healthy animals. The public slaughter of tuberculous cattle is always accompanied by a storm of protests from bystanders, which are generally quieted by the post-mortem results.

Although difficult to detect in its early stages, except by the use of tuberculin, the symptoms of tuberculosis are quite marked when the disease is well advanced. The following concise description of advanced bovine tuberculosis is taken from the Special Report of

the Bureau of Animal Industry on "Diseases of Cattle and Cattle Feeding," page 405. Lydtin quotes the following description of the disease as taken from a Swiss sanitary order:

"A dry, short, interrupted, hoarse cough, which the sick animals manifest especially in the morning at feeding time, still more after somewhat violent exertion. At first these animals may be full-blooded and lay on a considerable amount of fat when well fed. As the disease progresses they grow thin and show more and more those appearances which indicate diseased nutrition, such as staring, lustreless, disheveled coat; dirty, tense skin, which appears very pale in those regions free from hair. The temperature of the skin is below normal. The loss of fat causes sinking of the eyes in their sockets. They appear swimming in water and their expression is weak. The cough is more frequent, but never or very rarely accompanied with discharge. The body continues to emaciate even with plenty of food and a good appetite, so that the quantity of milk is small. At times in the early stages of the disease, still more in the later stages, the diseased animals manifest considerable tenderness when pressure is applied to the front or sides of the chest, by coughing, moaning, etc. Often all symptoms are wanting in spite of the existence of the disease."*

V. LESIONS OF BOVINE TUBERCULOSIS.

It is not a simple matter for the non-professional to detect bovine tuberculosis, and in many cases the trained veterinarian cannot determine its presence by physical examination. More definite knowledge may be obtained by the following means:

1. Examination of the sputa and milk with the microscope for the tubercle bacillus.
2. Inoculation of smaller susceptible animals (rabbits, guinea-pigs, etc.), with the suspected material.
3. Slaughter and post-mortem.
4. The injection of tuberculin.

Dismissing the first two means as not within the scope of this

*After mature consideration and consultation with the Board of Control of the Station and the State Board of Agriculture (acting as Cattle Commission) it was deemed inadvisable to attempt to describe the symptoms of bovine tuberculosis more fully than above, on the ground that they were so obscure and variable, except in advanced cases, that any description would be apt to be more misleading than instructive.

bulletin, the third may be used either alone or as confirmation of the fourth. In either case it is desirable to be able to recognize the lesions (changes produced in the texture of the organs by the action of disease) of tuberculosis.

The organs usually affected are:—

1. Breathing: The lungs, throat, and their glands.
2. Digestion: The stomach, intestines, mesenteric glands.
3. Abdominal glands and urinary organs: The liver, spleen, pancreas, kidneys, and bladder.
4. Reproduction: The womb, ovaries, and fallopian tubes.
5. Lactation: The udder and its lymphatic glands.
6. The lymphatic glands in general.
7. Serous membranes: pleura, peritoneum, pericardium.
8. The skeleton: bones, joints.

Sometimes but one organ is affected, sometimes several, the symptoms varying with the location of the disease. In the former case the disease is called localized, in the latter generalized tuberculosis.

The lungs and bronchial glands are most commonly affected, then the intestinal canal. The distribution of the disease in the various organs is well shown in the following tables of post-mortem examinations copied in a condensed form from the "Report on Tuberculosis in Ontario, presented to and adopted by the Provincial Board of Health, by P. A. Bryce, M. A., M. D. secretary." The results obtained in cattle by one of us is added at the foot of the table.

Class of Post Mortem.	By whom.	Number in each.	Lungs.	Bronchial and Mediastinal Glands.	Pleura.	Mesentery and Intestines.		Liver and Uterus.		Spleen and Udder.	
						Mesentery.	Intestines.	Liver.	Uterus.	Spleen.	Udder.
			%	%	%	%	%	%	%	%	%
Ontario Agricultural College herd	Mackenzie	28	64	85		7	7	42		.	7
Ottawa Experiment Farm herd	Robertson	30	83	73	26	13	4	43	6	.	....
New Jersey (cattle)	Conrow ...	48	70	56			.			2	25
Germany (cattle)	Roeckl	7329	75	29	55	48		28	10	19	....
Vermont	Rich.....	138	82	61	7	22	2	14	1	2	22

In 7,329 cases of more exact returns of post mortems in cattle, the results are given as follows :

		Per cent.
General tuberculosis	459	6.26
Lungs	5,178	75.37
Pleura pulmonalis	3,812	55.49
Peritoneum and mesentery	3,316	48.27
Pleura of chest-wall	3,209	46.71
Bronchial glands and mediastinal glands	2,022	29.43
Liver	1,940	28.24
Spleen	1,273	18.53
Uterus	699	10.17
Inguinal glands	364	5.30
Pharyngeal glands	299	4.35
Trachea	233	3.39
Udder	111	1.62
Intestinal	89	1.30
Ovary	86	1.25
Lymph glands of liver	80	1.16

The lymphatic glands of the thorax and abdomen, the heart, kidneys, stomach, brain, bones, etc., were found diseased in less than one per cent. of the cases.

Wherever the germs locate in the body, they multiply, thus irritating the tissue, forming a round nodular mass, the so-called tubercle, which gives the disease its name. The newly formed tubercle is always small, usually about the size of a millet seed,* is soft and red, or sometimes firm, white, and fibrous. In chronic cases, aggregations of small tubercles become soft and cheesy with a limy material in the centre, disintegrate and run together, forming yellowish, cheesy masses of various sizes imbedded in the tissue of the organs involved. These masses of degenerated or broken down tissue contain caseous (cheesy) matter, calcareous (limy, gritty) matter and pus, sometimes one, and often two or all, of these. This degeneration is caused by the actual death of the tissue. Unless the lesion is recent the mass is sometimes enclosed in several concentric layers of connective tissue like the skin of an onion, an effort on the part of nature to bury the diseased portion and render it harmless.

The surface of the lungs, pleura (lining of the chest cavity over the ribs and diaphragm), and peritoneum (lining of the abdominal cavity) are frequently studded with tubercles, being sometimes so thick as to resemble a cobblestone pavement, or, with clusters of tubercles which look like miniature bunches of grapes. This form of the disease is commonly called pearl disease, pearlsucht, grapes, angleberries, etc. Several of the Station herd were thus affected. The lymphatic glands are usually enlarged, caseated, and calcareous. They are often almost impossible to cut open, because of the deposit of gritty material. The bronchial lymphatic glands which normally are about as large as horse-chestnuts are particularly liable to enlargement and degeneration. The bowels may be ulcerated and have tubercles on them. In short, any organ affected will have tubercles in it varying from the microscopically small miliary tubercle through the pea-sized, soft red or firm white nodule, to larger masses of degenerated tissue, caseated, calcareous, or broken down into pus. Sometimes the tubercles are all so small that it requires a microscope to detect their presence. The cow,

* The comparison in size to a millet seed has given a name, acute miliary tuberculosis, to that form of the disease in which the tubercles are all small and form rapidly.

Creamer, belonging to the Station herd, was thus affected in the udder, there being almost no evidence of the disease elsewhere, She would have passed any abattoir inspection as sound and healthy, yet her udder was full of microscopic tubercles and her milk unquestionably infected.

These lesions are characteristic of the disease and their extent measures its progress. Glanders (which does not affect cattle), actinomycosis (lump jaw), and pleurisy with adhesions are the only diseases which are liable to be confounded with tuberculosis. Usually the restricted localization of the lesions of the two former will serve to distinguish between them. In lump-jaw the lung often contains cheesy masses, rather more yellow than are those due to tuberculosis and containing small grains. In pleurisy with adhesions, in which the lungs have to be torn away from the ribs, the absence of tubercles will aid in determining the character of the disease. Both glanders and actinomycosis are contagious to both man and beast. No mistake would be made in slaughtering the animal whichever disease was at fault.

The one entirely satisfactory evidence of tuberculosis is the detection of the germ and reproduction of the disease. If a germ is found in a nodule of any character which is a rod about one ten thousandth of an inch long, which both stains and bleaches with difficulty, it is probably tuberculosis. If the tissues injected into a susceptible animal produce tuberculosis, the diagnosis is established beyond question.

VI. THE TUBERCULIN TEST.

In August and November, 1890, Dr. Robert Koch,* the first to identify the tubercle bacillus, published the results of experimental work upon tuberculous guinea pigs with a fluid of his own preparation. This fluid (Koch's lymph or tuberculin) was stated at a later date to be the concentrated, sterilized, and filtered liquids in which pure cultures† of the bacillus tuberculosis had been grown.

It has been known for many years that animal decomposition and putrefaction are the results of bacterial growth. The growth of many of these germs gives rise to the formation of peculiar

* Deutsche Med. Wochenschrift, 1890.

† A pure culture consists of the growth of one species of germ by itself, all others being excluded.

alkaloids,* most of which are very poisonous. These bodies as a class are called corpse alkaloids or ptomaines, from $\pi\tau\omega\mu\alpha$, a dead body. The many cases of poisoning from eating cheese, ice cream, fish, and putrid meat are usually due to the formation of ptomaines in these materials. It is now believed that each disease producing germ develops, as a function of its life, ptomaines peculiar to itself. Many of these have been isolated and their properties determined. Tuberculin being a glycerine extract of pure cultures of the tubercle bacillus contains the ptomaines peculiar to that germ, the chemical poisons which the life functions of the germ have created. These are the immediate though not the ultimate causes of tubercular lesions.

Tuberculin is prepared by growing the tubercle bacillus in a pure culture until highly concentrated and until a large amount of its ptomaines is developed. Glycerine and carbolic acid are then added and the mixture is filtered through a porcelain plate to remove the germs. The filtered fluid is heated to a high temperature to destroy the vitality of any germs which may have passed the filter and then evaporated at a low temperature in a vacuum until concentrated. The German or Koch tuberculin is put up in five gram bottles and retails in New York for about $10 a bottle ($1,000 a pint). It is diluted one to ten, before use. The tuberculin made by the Bureau of Animal Industry is put up in 12 c. c. bottles and is used without dilution.

The test with cattle is made by injecting the fluid under the skin of the neck or shoulders by means of a sterilized hypodermic syringe. The syringe and the skin and hair at the point of injection are first carefully disinfected in order that no disease-producing germ may enter the system. The German tuberculin is diluted with nine times its volume of a one per cent. solution of carbolic acid, and from one to four cubic centimeters (a cubic centimeter is about one thirtieth of a fluid ounce) of the diluted lymph is used. The cost of the tuberculin used in an average sized injection is about fifty cents.

The normal temperatures are usually taken before and at injection. Tuberculous animals respond by a rise in temperature,

* Organic chemical compounds, existing in many vegetables and animals, containing nitrogen, carbon, hydrogen, and oxygen. They generally include the active principle of the plants. Examples: Theine in tea, morphine in opium, quinine in Peruvian bark, strychnine in nux vomica, tyrotoxicon in poisonous cheese, ice cream, etc.

usually beginning from six to ten hours after injection, but exceptionally not showing until as late as sixteen to eighteen hours. There is usually no marked swelling at the point of injection, but sometimes uneasiness, rigors, chills, and diarrhœa are noticeable. Diarrhœa often affects healthy cattle also, and is caused by the expulsion of the tuberculin by way of the bowels. In some of our work at this station and in the state the "normals" have been taken some days after injection. This has worked well and saved taking the "normals" of animals which later prove to be healthy. It is not safe, however, to take these temperatures the day after injection, as the temperature often rises the second day nearly as high as on the day after injection. All temperatures are taken by inserting a clinical thermometer into the rectum or vagina for from three to five minutes. Normal temperatures should be taken at least twice. The temperatures after injection should be taken at least once in three hours, beginning six hours after and continuing until twenty to twenty-four hours after injection. Variations occur in the normal temperatures of different cows and of the same cows at different times in the day. The average normal temperature of a cow is not far from 101.3°F. It may rise to 102.5° or sink to 100°. *An increase of 2° over normal temperature after injection is ground for suspicion*, unless there is evident reason for it (cow in heat or near calving, change of conditions or surroundings, etc.), while higher figures make the case yet more clear.

There is need of careful observation and trained intelligence in the interpretation of the results of the tuberculin test, since apparent reactions sometimes occur which might mislead the unskillful or careless. *The test is too delicate for ordinary hands.* The Bureau of Animal Industry and the importers of the German goods are exceedingly conservative in placing the lymph only with responsible parties.

The action of tuberculin upon the tubercle bacillus is that of an excitant. It arouses the germs to increased activity, hastens the progress of the disease, tends to scatter the infection throughout the body and throws the animal into a feverish condition, as shown by a rise of bodily temperature of from 2° to 8° F. The tubercular tissue degenerates rapidly through the usual stages, the germs rapidly increase in number, a new extension of the disease in the form of acute miliary tuberculosis usually occurs and death by so-

called "quick consumption" ensues. This action is what brought Koch's lymph into disfavor as a cure, except in cases of lupus (tuberculosis of the skin) and other localized forms of the disease where the diseased tissue is sloughed off. But the very features which prohibit its use as a cure are those which give it its value as a diagnostic agent (means of determining a disease by distinctive marks, symptoms, or characteristics) in cattle. The tuberculous animal because of the very presence and action of the tubercle bacilli in its system becomes more or less charged with tuberculin. The system is inured to this, however, but it is supposed that its balance is upset by the injection of more tuberculin, the germs are excited to greater activity and fever ensues.

Tuberculin was first used as a diagnostic agent in veterinary practice in 1891 by Prof. W. Gutmann,* of the Veterinary Institute, Dorpat, Russia. The tuberculosis commission of the veterinary department of the University of Pennsylvania, Prof. W. L. Zuill,† chairman, were the first to use it in this country, late in the same year. Many of the experiment stations, cattle commissions, and veterinary surgeons of this and other countries have experimented with it since this time and have generally found it successful.

The experiment stations of Canada, Vermont, New York, New Jersey, Pennsylvania, Virginia, Wisconsin, and Minnesota have used it with convincing results. A list of their publications on the subject will be found at the end of this bulletin.

Quotations might be made from the reports of many investigators, American and foreign, but the following may suffice:

"We shall now stop publishing reports on tuberculin in the *Berlin Veterinary Weekly* unless they contain some new facts or views. Since the publication of the reports of the extensive experiments of the Royal Health office, we may regard the question of the value of tuberculin in the diagnosis of tuberculosis of cattle as settled. The proof which has been presented to our readers is more than sufficient. The results are absolute and gratifying, and show that tuberculin is a reliable agent for determining the presence of tuberculosis in cattle." ‡

* Balt. Woch. f. Landw. Geweberfl. u. Handel; also reported in Deutsche Molkerei Zeit., 1891, pp. 81–83.

† Jour. Comp. Med. and Vet. Arch., Nov., 1891.

‡ Berliner Thier. Wochenschrift, June 16, 1892.

Objections to the Tuberculin Test.

Objections having some basis in fact have been raised to the use of tuberculin in veterinary practice. They are, briefly stated:

1. The temperature of healthy animals and those affected with other diseases sometimes rises after the injection of tuberculin.

2. Some tuberculous animals do not react to tuberculin.

3. Tuberculin does not determine the stage of the disease, but condemns animals which might live for years and possibly recover.

4. Tuberculin may produce the disease in healthy animals, and certainly hastens its progress in those affected.

5. Any test to be effective must be followed by thorough eradication. It is impossible to stamp out tuberculosis for financial reasons and because of its prevalence in the human family.

To the first, second, third, last half of the fourth, and the fifth counts in the indictment the test must plead guilty. *The tuberculin test is not infallible.* There have been mistakes made in its use by incompetent persons, and it has occasionally failed in careful hands. Experience, however, has brought a greater measure of success; unfavorable reports are now rare, and many who considered tuberculin unreliable are acknowledging that the fault was their own. But, notwithstanding its occasional and admitted failures, it has proved infinitely more reliable than any other means of diagnosis now in use.

Let us consider these objections:

1. *Apparent reaction of non-tuberculous animals.*—Every animal is liable to fever, and may be thus affected after a tuberculin injection independent of tubercular lesions. A cow for a few days before, at, and for some days after calving may have abnormally high temperature. Yet, on the other hand, one of us has had healthy cows calve in the middle of the test without showing any fever whatever. We have also found that the standing, due to the necessity of frequent taking of temperature, tends to cause acute laminitis (inflammation of the sensitive structure of the feet) accompanied by a rise of temperature, which might be mistaken for a reaction caused by tuberculin. The altered conditions of confinement during summer when the cows are naturally at pasture may also cause a fevered condition. Cows in heat are apt to be feverish. The temperatures of such cows fluctuate more than those of a

cow reacting to tuberculin. Such cases are usually readily detected by the careful observer. Great care should be used in the interpretation of the results of the injection of two-year-olds with their first calf. The explanation for this may be that the changes caused by their first gestation are such as to render their systems readily fevered by any excitement. Care should be taken not to inject directly into a lymph or blood vessel, lest neighboring glands become inflamed. Mistakes have been made by careless post-mortems, and many who have reported reactions in healthy animals are acknowledging that they failed to make careful examinations of all organs, bones, joints, etc., or did not use the microscope. It has been claimed that animals suffering from actinomycosis may react to tuberculin. From a practical standpoint, since lump-jaw is contagious, and communicated to man, this makes little difference, yet it is not impossible that there may have been tubercular lesions overlooked in these cases. One of us had two cases of this kind. One cow with lump-jaw gave no reaction whatever to tuberculin; another with both tuberculosis and lump-jaw gave the highest reaction (108.6°) yet obtained.

2. *Non-reaction in tuberculous animals.*—These cases are sometimes found. We have found two cases of non-reacting tuberculous cattle in over a thousand injected. This may be explained in two ways. It is a well known fact that some individuals are not affected in the ordinary manner by certain drugs. For instance, morphine does not narcotize some people. It is possible that these cases may be similarly explained. Or, the animal may be so thoroughly diseased that its system is already saturated with the natural tuberculin, so that the slight addition has no effect. Usually such cases may be detected without recourse to tuberculin or in spite of its lack of reaction. We have noticed in our experience that very old cows do not respond so readily to the usual amount injected.

3. *Indiscriminate Condemnation of all Stages of the Disease.*—Neither the length of time elapsing between the injection and reaction, the duration, or the height of the fever indicate the extent of the lesions of the disease. The slightest and most recent cases, as well as those of long standing are betrayed. Herein lies the peculiar value of the test. It is questioned by some veterinarians whether for practical purposes animals very slightly affected should be considered tuberculous. Probably many might live for years without

marked advance of the disease. But who shall say in such cases when the danger line is passed? Is it worth while to prolong for a year or two the life of a few confessedly tuberculous animals to run the risk of infecting a herd as well as human beings? While many animals but slightly affected might live for years in apparent health and usefulness, a tuberculous animal, whatever its condition, is a constant menace to the other members of the herd, and to those who care for it or consume its products. If to-day the germs are inactive, to-morrow they may pass into the blood, to the udder and infect the milk. It is stated on good authority that the tubercle germs may exist in the milk even when the udder is not affected. The preservation of a single tuberculous animal invites renewed disease. There are as yet few, if any, authenticated published accounts of cured bovine tuberculosis, although possibly favorable climatic conditions may arrest the progress of the disease. Viewed solely from a monetary standpoint the truer economy lies in the exclusion of every possible source of future infection.

4. *Production of the Disease in Healthy Animals and its Aggravation in Tuberculous Animals.*—Tuberculosis is primarily due to the tubercle bacillus. If the lymph is properly made and sterilized every germ and spore in it is killed, and hence it cannot cause the disease.

During the preparation of this bulletin one of us wrote to a large number of veterinarians all over the United States, asking among other questions whether it was possible for tuberculin to cause tuberculosis, or any other disease in a hitherto healthy cow. But two replies were received in the affirmative while a large number claimed the impossibility of such infection with properly made and carefully handled tuberculin. These two replies were received from gentlemen, eminent in the profession, who have been working together. They base their belief in the possible infection of healthy animals upon the fact that they have found the bacillus in tuberculin, and they claim that it is unwise to use the material until more is known of its power to produce immunity, or possibly a predisposition to tuberculosis.

The first claim simply emphasizes the necessity of care in the preparation and use of the material. The lymph was first used for diagnostic purposes in veterinary practice nearly three years ago, and the evidence is already strong against the probability of any

predisposition being caused. For example, the Pennsylvania Experiment Station herd was first injected in June, 1892, and has been twice injected since, the last time within a few weeks. The disease was discovered on the first injection, but not on either of the succeeding trials.* It is nearly two years since we first used tuberculin and cattle then injected and recently retested have shown no evidence of disease. While this evidence is only negative, it is confirmed by similar tests elsewhere. There is still much to be learned in the use of tuberculin. It is already claimed that other materials will cause the same febrile reaction. Taurin and Kreatin (Merck's) have given good results in the hands of Dr. W. L. Zuill of Philadelphia, and E. Centauni claims that "it has been proved that identically the same action as that of tuberculin can be produced by the injection of the extracts or other products of various bacteria, even such as are known to have no pathogenic (disease-producing) properties†." If further experiment confirms these results, and these or other materials are found to be as reliable as tuberculin, they should and undoubtedly will supplant it, since they obviate the danger which lies in careless making and use of tuberculin.

The aggravation of the disease in tuberculous animals is not a valid argument in cases where such as react are promptly killed. No one who expects to keep his mild cases should permit its use, for it only makes a bad matter worse.

5. *A thorough eradication an impossibility.*—The complete eradication of tuberculosis, its "stamping out," is not a work of years, but of decades, perhaps centuries. But increased knowledge and better means of detection enable us to make a stronger fight against it. We now know how and why it attacks, may detect its presence and do much to prevent its ravages. We may confidently expect yet more light as time goes on. If we cannot eradicate tuberculosis in the near future, let us do what we can in that direction.

When the great conflagrations of Chicago and Boston were at their height, the firemen did not reel up their hose and go home because the flames were apparently beyond their control. They worked around the edges of the fire, and blew up buildings yet unburned in its path. They did what they could and finally

* Penn. State Coll. Agl. Expt. Stat. Bul. No. 21, Oct., 1892.
† Berliner Klinische Wochenschrift, Nos. 7 and 8, 1894.

controlled the flames. Similarly, in the battle with human and animal tuberculosis, weeding out disease here and there, disinfecting, and the destruction of property in the shape of animals in the interests of the public health are good policy until better knowledge and means enable us to do more complete work. The question of the relation of the state to the individual and to disease will be considered elsewhere.

VII. INTER-RELATION OF HUMAN AND BOVINE TUBERCULOSIS.

Bovine tuberculosis is infectious. Hundreds of experiments have proved that this disease may pass from a tuberculous to a healthy animal. Stahl cites 650 experiments in the transmission of tuberculosis to lower animals by direct experiment with convincing results in every case. Koch* and others have inoculated healthy animals of many sorts with tuberculous bovine tissue and reproduced the disease. Bollinger,† Ernst, and Peters,‡ and others have infected calves and swine by feeding them tuberculous milk. The unboiled milk of tuberculous cows, without indications of diseased udders, infected a herd of English pigs.§ The mother of calf No. 3 of the station herd is healthy, and the tubercular mesenteric lymphatic glands of the calf were probably due to drinking the herd skimmilk. A litter of five pigs out of apparently strong and healthy parents were killed last winter by one of us. All were tuberculous, and in one case it was generalized and far advanced. They had been fed on the mixed skimmilk of a creamery, and on two different occasions cows supplying this creamery had been tested and killed because of tuberculosis. Many of the pigs fed on the skimmilk of the Mountain View herd at East Burke, Vt. (78 out of 91 cattle found tuberculous by the tuberculin test and confirmed by post-mortem), were found when butchered to be as tuberculous as the cattle. At another farm where the station veterinarian was called to use the tuberculin test, over sixty cows, over a hundred hogs, all the chickens, the dogs, and even the family cat were exterminated because of this disease. The location of the disease at both ends of the line of cows in the station

* Loc. cit.
† Munchener Med. Wochenschr, 1889.
‡ Publications Mass. Soc. Promot. Agr.
§ *British Medical Journal*, I, 1839, 30.

barn with but one diseased cow in the middle is suggestive in this connection.

Human tuberculosis is infectious.—This belief was held before the Christian era. About a hundred years ago the doctrine of hereditary transmission was advanced, but our present knowledge of its germ origin has forced the profession back to the old belief in infection with hereditary predisposition as an accessory cause. There are now scores of observations on record in medical journals which are positive evidence. Without going into details a few may be cited:

Italy's mild climate has long invited consumptives from every direction, who have so infected the country that even among its natives the disease is almost epidemic and its consumption death rate higher than that of any other European country.

"Prison consumption is notorious. Kennan* reports it to be a great scourge in Siberian prisons. There is usually a greater proportion of this disease in 'institutions' than where human life is less segregated. Cornet† found, during twenty-five years in the thirty-eight cloisters, 2,099 nuns acting as nurses had died. Of these 1,300 or sixty-three per cent. had died of tuberculosis, or four and a half times the usual percentage. This seemed due almost entirely to their greater exposure to infection."

A recent example close at hand may be found in the report for 1893 of Dr. J. B. Ransom,‡ physician of the state's prison at Dannemora, Clinton county, New York. He states that the percentage of total deaths from tubercular disease in that prison is over 80 per cent. In a private letter to one of us he states that he does not connect this with the milk supply, which is but small per man.

"In a lying-in hospital in Berlin was a nurse whose business it was to resuscitate children who were born asphyxiated by breathing into their lungs. Of ten infants so treated every one died of tuberculosis. The nurse died, and upon examination showed that her lungs were tuberculous. The children were shown to have been born of healthy parents."§

* *Century Magazine*, June, 1889, p. 172.

† Zeit. fur Hygiene, VI, I, 64.

‡ Annual Report of Supt. Prisons of the State of New York for 1893, p. 181; also Report Proc. National Prison Asso., 1894.

§ Betliner Klinische Wochenschrift, No. 37, 1878.

Three Grecian surgeons injected the sputa of a consumptive into the thigh of a fisherman whose death from gangrene was inevitable. Previous to injection they examined and found the lungs sound and healthy. He had no known hereditary predisposition to tuberculosis. In three weeks the lungs showed signs of disease, and at death (from gangrene) in thirty-eight days after injection, seventeen tubercles were found at the summit of the right lung, two on the upper part of the left lung, and two on the liver.*

Eight cases of consumption occurring within a few months in an English convent were traced to a single case. There had been no isolation, but all had slept in the same general dormitory. On isolation of the sick and proper disinfection the disease stopped.†

Biggs‡ cites a case reported by Schwenninger. Tappeiner conducted experiments on dogs, causing them to breath air artificially infected with tubercle bacilli. His servant not believing in the danger and disregarding warnings, persisted in entering the inhalation chamber. He was free from hereditary predisposition, robust and healthy. He died of acute tuberculosis in fourteen weeks, and an autopsy showed the same lesions as those found in the dogs.

Dr. Dewevre of Paris noted that three brothers, all his patients, successively sickened and died of tuberculosis. They had shared the same bed and were all bed-bug bitten. He found this bed over-run with bed-bugs, and learned that it had been thus infested for five years. Thirty bugs were caught and put upon three healthy guinea pigs, all of which soon died, and post-mortems showed well-marked tuberculosis. From the diluted and filtered pulp of fifty crushed bed-bugs bacterial cultures were obtained which caused typical tuberculosis when inoculated.§

Flies have sometimes been known to disseminate anthrax and other germ diseases. It is also claimed that they eat and disseminate tuberculous sputa, that the germ may be found in their bodies,‖ and that fly specks carefully removed from the material

* Gazette Medical de Paris, No. 17, 1872.

† *London Medical Record*, July 15, 1884.

‡ *Buffalo Med. and Surg. Journ.*, June, 1890.

§ Cressy: Report on Sanito-Veterinary Investigations, 27th An. Report Conn. Bd. Agr., p. 24.

‖ Spillman and Haushalter: La Semaine Medical, Oct. 15, 1887; also Gazette hebdom, de Med. et de Chir.

to which they clung and injected have caused tuberculosis in guinea pigs.*

A cook in removing a glass sputum cup broke it and a splinter of the glass punctured her finger. Two weeks later a swelling appeared, which grew until finally amputation was necessary. Examination showed numerous miliary tubercles containing the characteristic tubercle bacilli.†

A young surgeon, Laennec ‡ by name, had a somewhat similar experience. He wounded the index finger with a saw blade while cutting a tuberculous vertebra. A small rounded tumor with the physical characteristics of tubercle appeared at the spot and was removed.

Dr. Eve § relates the cases of two children circumcized when eight days old in the Jewish manner by a tuberculous rabbi. In one case at six weeks tubercular swellings developed and in five months caseous abcesses formed, the material of which injected into guinea pigs induced general tuberculosis. The other child showed similar symptoms.

Dr. H. C. Earnst ‖ stated that he "had here something like two thousand references to articles written in all languages, and in different parts of the world, bearing upon and proving the infectious nature of tuberculosis, including only the literature extending over about the past seven years."

Human and Bovine Tuberculosis are identical. The germs, the lesions, and in many respects the symptoms are the same. Lower animals inoculated with the tuberculous products of man contract the disease, the results are precisely the same as when the products of other animals are used, and the microscope shows the same germ present. Dogs, cats, and poultry have in many cases on record ¶ become infected from eating human sputa, while guinea pigs inoculated with fresh or dried sputa, or forced to inhale the

* Hoffman: Deutsche Med. Zeit. July 16, 1889.

† Tsherming: Progress Med. 1885.

‡ Abhandlungen von den Krankheiten der Lungen, Leipzig, 1832. Said to be the first recorded successful inoculation with tuberculous matter.

§ *Lancet*, Jan. 28, 1888.

‖ Hearing on the "Dangers to Human Life from Bacilli of Tuberculosis in Milk" before the Committee on Public Health of the Massachusetts Legislature of 1891.

¶ Peters; Vet. Journal XVIII, 1887, p. 394; Nocard; Recueil de Med. Vet. annexe, 1888, 537; *ibid.* 1889, 66; *ibid.* 1885 annexe, 93: LaMalleree; La Semaine Med, 1888, and others. See also 6th and 7th Reports Bureau of Animal Industry 1888-1890, p. 47, 48.

dust of dried sputa, have succumbed to tuberculosis. There is no reason to believe that larger animals may not as readily be infected in the same manner.

Human tuberculosis infects the lower animals, and, what is vastly more important, and the central fact which prompts the publication of articles of this nature, BOVINE TUBERCULOSIS INFECTS MAN.

Bovine Tuberculosis Transmissible to Man.

It is obvious that direct experiment on man with tuberculous material from the lower animals is out of the question. There are on record, however, a number of cases of accidental infection of human beings by the products of tuberculous cattle. There is reason to believe that countless thousands of deaths have occurred due to this source of infection, which have not been thus ascribed and of which no record has been made. Children are more likely to be infected than adults, owing to their tissues being less resistant and because their chief food is milk. It should not be inferred, however, that disease and death of necessity follow the consumption of tuberculous meat or milk. The following are some of the authenticated cases of accidental infection which have come to our notice. It is not to be inferred that they are of necessity all or the strongest on record.

Dr. Anderson of Seeland reports a case of a babe fed on the milk of a cow having tuberculosis of the udder. The child died at six months with tuberculosis. The mother also developed symptoms of the disease after the child's birth. It was considered that both contracted the disease from the cow's milk.*

Ollivier † at a meeting of the Academie de Medicine of Paris stated that a patient of his, a young woman twenty years old, of vigorous health and without constitutional trouble, had acute tubercular meningitis (inflammation of the membranes of the brain of tubercular origin). She had been educated at a boarding school where thirteen pupils had been ill of, and six had died of, tuberculosis within a few months. The milk supplied to the school was from cows kept on the place. Upon examination these

* Hatch Exp. Station of Mass. Ag'l College, Bul. No. 3, p. 15.

† Bacteriological World, Aug. '91, translated from Allgem. Med. Cent. Zeit.: also La Semaine Médical, Paris, Feb. 25, 1892.

animals were found to have tubercular ulcers on their udders, and after being slaughtered were found to be generally tuberculous.

A Scotch family, all of sturdy health, had a herd of cattle which developed tuberculosis. Two daughters, being young, were brought up on the milk. Their two older brothers were more fond of whiskey than of milk. They are living healthy and hearty, while their two sisters are lying in their graves, victims of tuberculosis.*

In the practice of Dr. Stang of Amorback a well-developed five-year-old boy from sound parents, whose ancestors on both sides were free from hereditary taint, succumbed after a few weeks' illness with acute miliary tuberculosis of the lungs and enormously enlarged mesenteric glands. A short time before the parents had their family cow killed and found her the victim of advanced pulmonary tuberculosis.†

Dr. Demme records the cases of four infants in the Child's Hospital at Berne, the issue of sound parents, without any tuberculous ancestry, that died of intestinal and mesenteric tuberculosis, as the result of feeding on the unsterilized milk of tuberculous cows. They were the only cases in which he was able to exclude the possibility of other causes for the disease, but in these he was satisfied that the milk was alone to blame.‡

The infant son of a college mate of one of us, a comparatively strong and healthy child of twenty-one months, visited his uncle for a week. While there he drank the unsterilized milk of a cow which was soon after condemned and killed in a state of generalized tuberculosis. A few weeks after his return the child began to fail and died three months after the fatal visit, a mere skeleton, with tabes mesenterica, or consumption of the bowels. Both of the child's grandfathers had died of tuberculosis when over sixty years of age as well as two grand aunts and one grand uncle. The child never saw but one of these, and him but two or three times and for short intervals only. A second child brought up on§ sterilized milk is in robust health. Both parents are in excellent health.

A child four years old, great grandson of Henry Ward Beecher,

* Discussion on Tuberculosis, Meeting Nat. Vet. Ass'n, London, May, '83. Extracted from Lecture to Md. Sanitary Council by Dr. Robt. Ward, 1886, p. 10.

† Law: Cornell University Exp. Stat., Bul. No. 65, p. 137.

‡ Law: Cornell University Exp. Stat., Bul. No. 65, p. 137.

§ Private letter to J. L. H.; also reported by Law, *ibid.*, p. 137.

died last March at Yonkers, N. Y., of tubercular meningitis. The diagnosis was confirmed by specialists. There were no hereditary tendencies to the disease known. The certainty that he had the disease, and the inability to account for it from human agencies led the physicians to suspect the milk of two Alderney cows on which the child had been mainly fed. Both the tuberculin test and the post-mortems showed that both animals were tuberculous. Through the kindness of Dr. J. S. Lamkin of Yonkers, who made both tests and post-mortems, sections of the lungs and a gland were sent to us. They were found to be highly tuberculous.*

May 30, 1879, a cow died of generalized tuberculosis in Providence, R. I., the lungs, most of the abdominal viscera, muscular tissue, and udder being tuberculous. The milk had been used in the family. In August the baby was taken sick and died in seven weeks of tubercular meningitis. Post-mortem showed tubercular deposits in the membranes covering the brain, and some in the lungs. Two years later a two-year-old child in the same family died of tubercular bronchitis and seven years later a nine-year-old boy, "delicate" for years, died of "quick" consumption. So far as known the family on both sides were rugged and healthy.†

Dr. H. M. Pond‡ reports four cases of tuberculosis in one family, of which three were fatal. He considered the milk of their cows to be the source of the disease, since those animals were apparently tuberculous.

In the spring of 1890 Dr. Gage, city physician of Lowell, Mass., had as a patient an infant which died of tubercular meningitis. Its parents were healthy and surroundings good. It had never been fed anything but the milk of a single cow. The cow's milk was microscopically examined and found to contain the bacilli of tuberculosis. Guinea pigs inoculated with her milk developed the disease. A second child fed upon the same milk was developing similar symptoms to those discovered in the child that died. Dr. Gage could find no way to prevent the sale of the milk unless he bought and paid for the cow out of

* N. Y. *Sun*, March 29, '94. Also private letters to J. L. H.

† Ernst: Report to Mass. Soc. Promot. Agr., p. 4; also reprint in Hatch Exp. Stat. of Mass. Ag'l College, Bul. No. 8, p. 16.

‡ Pacific Med. & Surg. Jour., 1888.

his own pocket. So far as he knew she was still being used for a milk supply a year later.*

The following cases of infection from eating meat or direct inoculation may be cited.† A woman whose ancestors were without tuberculous taint ate eleven chickens bought from a neighbor. These chickens had been in the habit of greedily eating the spittle of their consumptive owner. They were but slightly roasted before eaten. The woman soon developed a well-marked case of tuberculosis of the bowels.

Dr. Treon‡ describes the poor, emaciated, diseased animals furnished to the tribes of Northwestern Indians, how they eat the liver, tallow, and entrails raw and fresh, and how the carcass is dried, pounded, and packed in skins to be eaten later, uncooked, even though the animal died of disease. The Indian mortality from consumption is 50 per cent. of all deaths at several points, while at Crow Creek, Dakota, 50 out of the total Indian population of 1,200 die yearly of consumption and scrofula.§

Dr. Washington Matthews‖ spent twenty-one years among the Indians. He states that their food is the primary cause of disease among them, and that when the supply of fresh beef is liberal the consumption death rate is highest.

A gentleman after eating something infected with tuberculosis has a nodule of tuberculous tissue form upon his tongue.¶

Tscherming attended a veterinarian who cut his finger during a post-mortem on a tuberculous cow. An ulcerated swelling formed which on removal proved to be tuberculous and contained the characteristic bacilli.**

Law†† reports a case in his personal experience precisely parallel with Tscherming's.

Pfieffer attended a veterinarian of good constitution, without hereditary predisposition, who cut his right thumb deeply during a post-mortem on a tuberculous cow. The wound healed but remained swollen. A year later pulmonary tuberculosis had

* Ernst: Hearing before Committee on Public Health, Mass. Legislature of 1891; Publications Mass. Soc. Promot. Agr., p. 19.

† La Malleree;—La Semaine Med., 1888.

‡ Amer. Practitioner; quoted by Law, *ibid.*, p. 131.

§ Holder;—*Medical Record*, Aug. 13, 1892, quoted by Law, *ibid.*, p. 131. Scrofula is usually of tuberculous origin.

‖ Census of 1880.

¶ Ernst: Hearing, etc., p. 6.

** Law, *ibid.*, p. 318.

†† Law, *ibid.*, p. 318.

developed and in two and a half years after the wound the man died. Post-mortem examinations showed tuberculosis of the joint of the wounded thumb and of the lungs.*

Dr. Ernst† sent a letter of inquiry to about 2,000 medical men and veterinarians of the highest standing. "Out of 1,200 or 1,300 answers received but two expressed an absolute disbelief in milk as a vehicle for the virus of tuberculosis; there were a large number who expressed their belief in it; a large number who stated, what is perfectly true, the difficulty of proving such a thing but expressed their belief in it; and a comparatively small number who furnished me with cases which they believed were distinctly traceable to the milk coming from tuberculous cows.

"I have records of cases of probable infection of children from the milk of mothers with tuberculosis of the lungs and mamma. I have cases of the infection of children from milk coming from tuberculous cows. I have a large number of cases from veterinarians showing the infection of calves from tuberculous cows; and it seems to me that the amount of evidence obtained from the clinical side is very great."

Dr. E. O. Shakespeare, ex U. S. cholera commissioner, says "With all its terrors it (cholera) is not nearly so deadly as is tuberculosis,"‡ and "It has been found that in infants and young children in some large cities the mortality from some form of tuberculosis is far greater than is generally believed, amounting in some localities to one fifth of the deaths in the young. The significant fact in this connection is that it is most frequently some part of the digestive passages that became first affected."§

In this connection by way of negative evidence it is interesting to compare the geographic distribution of cattle and tuberculosis. Dr. E. F. Brush‖ of Mount Vernon, N. Y., has given years of study and investigation to this matter, and in his papers scattered through the New York *Medical Journal* makes the statement that tuberculosis does not exist among people which do not employ milch

* Law, *ibid*, p. 318.

† Ernst, *ibid*, p. 9.

‡ Report 4th Annual Meeting Farmers' Inst. New Castle Co., Delaware, p. 16. "Relationship existing between Human and Bovine Tuberculosis," June 15, '89, pp. 645-650; "On the Coincident Geographical Distribution of Tuberculosis and Dairy Cattle," March 8, '90, pp. 253-256; "Sterilized Milk," June 20, '91, pp. 719-721; "One of the Apparent Reasons why Man is afflicted with Tuberculosis,' Dec. 10, '92, pp. 657-659.

§ *Medical News*, March 26, 1892.

‖ N. Y. Med. Jour.; "Bovine Tuberculosis," March 24, '88, pp. 314-317.

cattle. The inference to be drawn is not that human tuberculosis comes mainly from cattle, for man gets his infection mostly from his fellow man, but that possibly the primary source of infection and more or less of its maintenance and extension are due to cattle. Whatever be the inference there is little question that human consumption is relatively less prevalent in countries where there are few or no cattle (Hebrides, Iceland, Newfoundland, Algiers, interior Southern Africa, parts of Ecuador and Peru and islands of the Pacific) and where reindeer (Northern Norway, Sweden, Finland, Lapland, Greenland) goats, or mares (Kirghis Steppes) furnish the milk. In some of the western South American countries cattle are used only for beef, since "so many cases of consumption have been traced to its (milk) use, that the entire population (of Eastern Peru) with scarcely a single exception leave it entirely alone."*

Is the milk of a cow dangerous if the udder is not affected? Authorities differ. Koch,† Nocard,‡ and others failed to infect animals with milk from tuberculous cows whose udders were unaffected. On the other hand, Bang,§ Bollinger,‖ Hirschberger,¶ Ernst and Peters,** Smith and Kilbourne,†† and Law ‡‡ have succeeded in infecting animals with the milk of tuberculous cows with apparently sound udders. In Bang's work most painstaking microscopical examinations of the udders of six cows giving infectious milk failed to show lesions. The conclusions drawn by Ernst and Peters from their careful work at Mattapan, Mass., are:

1st. And emphatically, that the milk from cows affected with tuberculosis in any part of the body may contain the virus of the disease.

2d. That the virus is present whether there is disease of the udder or not.

* Loc cit.

† De Kalb in "Nation." Quoted by Bact. World, 1-3 p. 217.

‡ Recueil de Med. Vet. annexe 1885, p. 49.

§ Deutsche Zeit f. Thiermed XI-45, 1885, also Congress pour l'etude de la Tuberculose, 1888.

‖ Deutsche Zeit f. Thiermed XIV, 264.

¶ Deutsche Arch f. Klin. Med. XLIV, 500; also Internat. Klin. Rundschau, Sept. 22, '90.

** Trans. Assoc. Amer. Phys., IV, 1889. Report to Mass. Soc. Promot. Agr. Hatch Agl. Exp. Sta. Bul., 8.

†† Bureau of Animal Industry, Bul. 3; also 8th and 9th Reports same, p. 64.

‡‡ Cornell Univ. Exp. Stat. Bul. 65, p. 136.

3d. That there is no ground for the assertion that there must be a lesion of the udder before the milk can contain the infection of tuberculosis.

4th. That, on the contrary, the bacilli of tuberculosis are present and active in a very large proportion of cases in the milk of cows affected with tuberculosis but with no discoverable lesion of the udder.

The fact that bovine tuberculosis may be transmitted to lower animals is absolutely proved by hundreds of positive experiments, and that it may likewise infect human beings through association and by their consumption of meat and milk, while not proved by direct, positive, intentional experiment, is placed practically beyond doubt by many observations of accidental infection.

Can the germ be killed and tuberculous meat and milk be made safe to eat by cooking?

The beef muscle is seldom affected but the small lymphatic glands between the muscles, commonly cut and eaten in steaks and roasts, are often diseased. The flesh itself of the pig is affected, and tuberculous pork is much more dangerous than tuberculous beef. The interior of a rare roast or steak is not heated to a point to insure safety, but all germs in a well-done or well-boiled piece are usually killed.

If milk be boiled for half an hour or heated by steam to 212°F practically all germ life will be destroyed. If heated to 150° to 167°F for half an hour to an hour and then cooled (rapidly if possible), the growth of such disease producing germs as are not killed is retarded for a period of twenty-four hours or more. The albumen is not coagulated at these temperatures, the milk is more palatable and digestible than if sterilized and is practically safe for prompt use. Pasteurized milk will not keep quite as long as sterilized milk. *Either sterilization or pasteurization is highly desirable with milk intended for children,* and is not a serious task. If bottles, one-half to three-fourths full of milk, are steamed for half an hour in a common steamer on the kitchen stove all disease germs will be killed. The mouths of the bottles should be then plugged with clean absorbent cotton or cotton wool as soon as removed from the steamer in order to keep all germs out. Half-pint beer bottles with patent stoppers, costing sixty cents a dozen, are used in the family of one of us, and the milk is pasteurized with

the stoppers closed as suggested by Cary.* A good milk sterilizer complete may be bought for from two to three dollars.

Three different models of milk sterilizers are shown herewith. The "Arnold" sterilizer is made by Wilmot Castle & Co., 14 Elm St., Rochester, N. Y., and sells, with bottles, for $2.50. A recent modification of this apparatus enables pasteurization or sterilization in the same apparatus. A copper sterilizer of this pattern with six patent stopper bottles made to order in Burlington cost $2.30.

Dr. Law† points out a hitherto unappreciated source of danger in the use of the products of tuberculous animals even after complete sterilization. He draws a distinction between tubercular poisoning and tubercular infection. The product of the life of the tubercle bacillus is tuberculin. Its ptomaines, being lifeless, are not killed, but are intensified by heat. This material being generally diffused throughout a tuberculous subject exists in its products. Hence, those consuming its products, even though they are sterilized, are taking small doses of tuberculin, and if they are already tuberculous the effect may be to stimulate and extend the disease. The transmission of the germ is admitted to be more common from man to man than from animal to man. Though thus implanted, its subsequent destructive progress may be largely due to the constant accessions of the soluble poisonous products of tuberculous meat and milk without which the implanted germ might have lain dormant. The reasoning from known facts is logical and Dr. Law's point seems well taken. If this be true it goes far towards explaining why tuberculosis is comparatively rare in countries where cattle are few. It tends to place the blame for the extension, if not for the inception, of disease upon the bovine species.

Were it not for the use of tuberculin as a diagnostic agent the consumer might be considered to be between the devil and the deep sea, with tubercular infection on the one hand and tubercular poisoning on the other.

The reader should neither infer that there is of necessity more bovine tuberculosis now than in years past, nor that the danger to human life is greater. If some of the customs of modern life have increased our dangers, others have decreased them. We are hear-

* Alabama Agl. Exp. Station, Bul. 53.
† *Ibid.*, p. 138.

ing more about tuberculosis now than ever before, simply because we know more about it. But so long as the human death rate from this disease remains at its present height, it will be profitable to continue to discuss measures for its prevention. Nor should our dairymen and breeders become needlessly alarmed. Probably not one animal in thirty throughout the state has the disease, and there are thousands of herds entirely free. What we need is simply that all realize the nature and conditions of the disease and of its spread. This done they can breed aud care for their stock understandingly, weed out suspects at once, disinfect where needed; in short, use all possible precautions to avoid the disease. To this end a full, free, temperate, and intelligent discussion is invited.

Is bovine tuberculosis curable? The usual opinion is that treatment is of little avail, that it is troublesome and costly, and that the results are unsatisfactory. Some believe that climatic change benefits cattle as it does mankind. It is true that the steers of the high altitudes of the West are practically free from this disease. It is doubtful, however, whether it would pay to try climatic change upon many animals or whether Western stock owners would admit confessedly tuberculous animals among their hitherto unaffected stock. The proverb, "An ounce of prevention is worth a pound of cure," is applicable to this disease. We may look forward to curative measures in the future, but at present the means are not known.

8. PREVENTION.

Since the results of curative treatments are unsatisfactory, and prevention is the watchword, *how may the disease be most surely prevented? Both human and bovine tuberculosis are distinctly preventable.* The measures that may be taken to prevent its spread are, briefly:

1. *Rigid official inspection of cattle, meat, and milk.*
2. *The immediate destruction or sterilization of human sputa and all tuberculous discharges.*
3. *The careful disinfection of rooms, hospital wards, barns, etc., occupied by tuberculous men or animals.*

Though thus briefly summed, the execution of these measures involves a mass of details. Sumptuary laws are always difficult to enforce and questions of possibility and expediency should enter into

consideration before enactment. "The fountain cannot rise higher than its source," and until the people thoroughly appreciate the dangers and understand the cause and means of prevention of tuberculosis, its control will be difficult.

The following precautions will be found useful by the stock owner in weeding out or keeping out tuberculosis :

1. The cow stable should be light, well ventilated and dry, the water pure and fresh, the feed nutritious and plentiful, the breeding judicious, with due regard to constitution.

2. So far as possible cattle should be kept from licking each other, from eating from the same manger, and from interchange of mangers.

3. Suspected animals should be isolated, should neither eat nor drink from a common manger or drinking trough, nor should their orts be fed to other cattle. Old cows, those having husky or rattling cough, wheezy breathing, nasal discharge, enlarged glands under the skin, diseased udder, garget (sometimes), diseased joints, etc., unthriftiness in general, cattle with weak constitutions and poor physical conformation (narrow chest, light barrel, long legs, pot bellies, etc.), are most open to suspicion. Such animals should be examined by a skillful veterinarian, and in case of doubt should be tested with tuberculin. If a single animal shows tuberculosis, the whole herd should thus be tested.

4. No new animal should be admitted from herds in which contagious disease has existed, from city or swill stables, or that shows signs of disease or unthriftiness, unless tuberculin tested. It is almost equally desirable that unsuspected animals also be thus tested.

5. No consumptive person should work with live stock or prepare their food.

6. All tuberculous animals should be killed and their carcasses either burned or deeply buried in places where animals have no access.

7. Disinfection should be thorough and extend to all products of and articles used by the cattle. The means used at this station were burning sulphur in the closed stable, washing or spraying every square inch of surface with a solution of one part corrosive sublimate in one thousand parts of water, and the replacing of all the wood-work of the mangers. *Corrosive sublimate is a violent poison and should be used with care.*

The following directions for disinfection will be found useful in cases of animal disease:

1. Remove and burn all loose litter, hay, rubbish, etc.

2. Wash all mangers, hay racks, and all wood work with a dilute solution of corrosive sublimate as stated above.

3. Whitewash all the inside of the building, especially mangers, hay racks, etc., and all wooden utensils used in the barn with a whitewash containing one pound of chloride of lime to four or five gallons of water.

4. Remove and burn all rotten wood work, particularly about the mangers, drinking troughs, etc. It is advisable to replace these even if sound.

II.

Upon the subject of the prevention of tuberculosis in the human family Prof. Frederick G. Novy, Sc. D., M. D., University of Michigan, says: With the fact before us that tuberculosis is a communicable disease, it follows that every effort that can be made by the individual and by the state should be exerted in the endeavor to decrease, if not suppress, this dread scourge of mankind. Once smallpox merited this distinction, and leprosy was at one time widely prevalent, yet, by the adoption and enforcement of special measures, these diseases are now exceedingly rare in civilized countries. May we not hope that in the future Hygiene may point with equal pride to the restriction of other infectious diseases just as today Medicine is proud, and justly proud, of the triumphs of antiseptic and aseptic surgery?

Any rational method for the prevention of infectious diseases must take into consideration the nature and properties of the causative organism—the mode by which it gains entrance into the body, the way by which it leaves the diseased individual, and its distribution in nature outside of the body.

The several avenues by which the tubercle bacillus gains entrance to the body have already been touched upon. The most destructive form of the disease is pulmonary tuberculosis, resulting from infection along the respiratory tract. It is the most common and dangerous form, and against it, therefore, all efforts at prevention must primarily be directed.

There are only two conceivable ways by which the tubercle bacillus can leave the diseased lungs and these are in the expired air and in the sputum. So far as the first of these is

concerned, it can be shown on physical as well as experimental grounds that it is impossible for the tubercle bacillus or any other organism to leave a moist surface and be carried off by a current of air. Direct examination of the expired air of consumptives confirms the absence of the tubercle bacillus. On the other hand the sputum is known to contain tubercle bacilli, frequently in enormous numbers.

The sputum is the principal means by which the tubercle bacillus leaves the body. In secondary infection the urine or the fæces may of course contain it. Bearing in mind the fact that an organism cannot leave a moist surface and pass into the air, it follows that sputum as long as it is moist is without danger. It may, it is true, if introduced into a cut or wound give rise to inoculation tuberculosis, or if eaten by an animal induce the intestinal form; but as long as it is moist there is no danger of infection in man along the respiratory tract.

The sputum, however, becomes dangerous as soon as it has dried down, become pulverized, and the fine particles scattered through the air by currents or in the process of sweeping.

The infectious character of sputum, whether moist or dried and powdered, is not a supposition but is based upon plain facts. That there are tubercle bacilli in the sputum which are alive and virulent is demonstrated almost every day in bacteriological laboratories. Some of the tubercle bacilli in the sputum may be dead and undoubtedly are dead. That is something that would be naturally expected. Death goes always hand-in-hand with life and what is true of man is also true of lower forms. Communities of men are never without their dead, without their cemeteries, and colonies of tubercle bacilli cannot be expected to follow other laws of life. No matter how many of the tubercle bacilli are dead, as long as there are some which are alive they are virulent and therefore capable of inducing infection.

Not only are there tubercle bacilli contained in the sputum which are alive and infectious, but—what is of almost equal importance in the consideration of prevention—they are highly resistant to destruction. The experiments of Schill and Fischer have shown that dried, powdered sputum preserves its virulence for at least six months, and Cornet's observations demonstrate that thin layers of dust from the walls of the rooms of consumptives contain virulent tubercle bacilli for at least six weeks. Furthermore, the experiments of Albu and Weyl deserve to be

mentioned in this connection, since they show that the sputum of consumptives treated with creosote for a long time and in large amounts still contains living, virulent tubercle bacilli.

The danger of infection from tuberculosis exists, then, in the sputum after it has dried down and become pulverized. As long as a consumptive discharges the sputum into a suitable receptacle which can be washed out or disinfected, there can be absolutely no danger of infection.

Sputum becomes dried and powdered in one or two ways. It is either discharged upon the floor, where it dries and eventually becomes pulverized and scattered about; or the sputum is received into handkerchiefs, within the folds of which it soon dries up. Of the two practices, the latter is undoubtedly the more common and the more dangerous. Every time the handkerchief with its dried contents is removed from the pocket, abundant opportunity is given for the scattering of tubercle bacilli. That tubercle bacilli are present in dust, and hence in the air, of rooms occupied by consumptives, has already been mentioned.

Another observation regarding the tubercle bacillus deserves to be stated, as it materially increases the possibilities of prevention. The tubercle bacillus is practically an obligative, parasitic organism. In other words, it is compelled to grow within the living body. It is only under very special, highly favorable conditions that it can be caused to grow outside of the body. Thus, a special medium, as blood-serum or glycerin agar, and a suitable temperature approximating that of the body, must be supplied. On ordinary media and at ordinary temperatures it will not grow. So far as known, it cannot grow and multiply under the natural conditions existing outside of the body. The living tubercle bacilli which are contained in the sputum given off by a consumptive, do not and cannot multiply; they either eventually die, or, if by chance they are introduced into the living body, growth and multiplication may result.

In view of the facts that the dried, powdered sputum is practically the only source of infection, and that the tubercle bacillus is incapable of multiplication outside of the body, it follows that the distribution of this micro-organism in nature is not as universal as is so frequently supposed. The tubercle bacillus is not ubiquitous, and there is absolutely no reason, except imagination, to believe that each and every individual is

constantly inhaling, or has already inhaled, numerous tubercle bacilli. Tubercle bacilli have been found only within the immediate surroundings of tuberculous persons—that is, within the rooms which they occupy—and then only when the first principles of cleanliness as well as of prevention are neglected.

The measures for the prevention of the disease, though exceedingly simple, require, nevertheless, the most careful attention on the part of the diseased persons as well as on the part of those whose duty it is to see to their needs and wants. A consumptive is not only a source of danger to his associates, but is likewise a source of danger to himself. The measures necessary for the protection of others are equally important to himself, as the chances for the re-introduction of the tubercle bacillus and the direct infection of otherwise healthy organs or parts of organs are in inverse proportion to the care which he takes in preventing the scattering of the organisms.

The means, then, by which restriction and prevention can be secured, are the outcome of the study of the facts observed in connection with the disease. Under no condition should the sputum be discharged upon the floor, and when by accident this does occur it should not be allowed to become dry, but should at once be washed off. The handkerchief should, likewise, never be used for the collection of sputum. Should it, however, become accidentally soiled, as in sudden, violent coughing, it should be washed as soon and as thoroughly as possible in boiling water. The same applies to bedding, etc., whenever soiled in this manner.

The sputum should always be received in a covered receptacle, within the room as well as on the outside. This should preferably contain a little water to assist subsequent cleansing. The use of sand, sawdust, etc., within such receptacles is not desirable, as desiccation is thus favored and subsequent cleansing is rendered more difficult. The collected sputum may be disinfected, or it may be washed out with boiling water directly into a closet.

Direct contact with the lips of tuberculous persons should be carefully avoided. Instruments, playthings, dishes, eating utensils, etc., which have been in contact with the mouth, should never be used by others without thorough disinfection. A tuberculous person should never masticate food for children, or touch a bleeding wound with his mouth. Vessels which receive the urine or fæces—although these are usually free from bacilli

except in cases of secondary infection or in the event of primary infection of the intestine or urinary organs—should always be cleansed and washed as soon as possible.

The room occupied by the consumptive should be kept rigidly clean and thoroughly ventilated. Dry sweeping should never be resorted to. In the event of death or removal, the room, its furniture and equipments should be thoroughly cleansed, and such articles as can be subjected to disinfection with steam or boiling water should be so treated.

A tuberculous mother or a tuberculous nurse should not be allowed to nurse a child. The meat and milk from tuberculous animals, owing to the danger of giving rise to intestinal tuberculosis and possibly to the pulmonary form, should never be used unless thoroughly sterilized by boiling or cooking. The absolute prohibition of the disposal or sale of such articles is unquestionably impossible, and undoubtedly unnecessary.

Lastly, it is evident that these precautionary measures, simple as they are, can best be carried out in special hospitals for the care of consumptives. Absolute segregation, as practiced with leprosy in some countries, is unnecessary, and would give rise to much hardship, and would be impossible. A large portion of the sufferers can be taken care of intelligently and properly in their own families; on the other hand, a very large number (and this is especially true among the poorer classes) cannot, they can barely lead an existence, and so long as they do live under the usual conditions they are a constant and positive source of danger to the community. It is clearly the duty of the State to take care of those that cannot take care of themselves. For such the State should erect, support, and maintain hospitals in which the homeless, friendless consumptive can receive the best care that the teachings of science can indicate.

In discussing the same subject Dr. Henry B. Baker, the efficient secretary of the Michigan State Board of Health, says: It seems to me quite possible for a consumptive person to so care for the general safety that he may move freely in private and in public without danger of spreading the disease. But in order that this may be done, it is essential that the consumptive person have complete knowledge of the methods by which consumption is spread, and by which it is restricted. And he must have also a conscientious determination that the specific cause of the disease shall be promptly destroyed, and not permitted to endanger

the life of another person. If the patient has not that knowledge, is not capable of comprehending it, or if he has not also a conscientious regard for the safety of others, the public interests demand that such a person having well-developed consumption of the lungs shall be isolated, for the public welfare, because he has the most dangerous communicable disease now known to us. The best place for all such persons is in a special hospital, where under well-planned rules and trained attendants the danger of spreading the disease shall be reduced to the minimum.

It is evident that the idea of isolating consumptives is extremely unpleasant to many people, probably to all, unless through a study of the subject it has come to be realized how great is the price humanity pays for the freedom accorded to consumptives. I believe it is practicable for intelligent, conscientious consumptives to so act as to avoid spreading the disease, and to do this without any great degree of isolation. The question is restricted, therefore, to the propriety of enforcing care for the rights of the whole people upon those consumptives who are incapable of taking, or unwilling to take the necessary care to avoid jeopardizing the lives of those who may come within the circle of their infection ; for myself, I have no hesitation in expressing the belief that all such consumptives should be isolated. Consumptives in asylums, prisons, poor-houses, and reformatories should be isolated. And consumption is one important factor in filling all such local and State institutions.

The State Board of Health recommends the disinfection of all sputa of all consumptives. If all consumptives would do this the problem of restriction would be simple. It will probably be a long time before this can be brought about through the voluntary action of all individuals. The intelligent and honest portion of our people can soon be taught to do this. Then their danger will still continue to be great through ignorance, carelessness, and willfulness of the lower classes of inhabitants. When that time arrives, the greatest good to the greatest number, and especially the law of "survival of the fittest" will dictate that restrictive measures be something more than "moral suasion." Disinfection of the sputa will then need to be made compulsory, and those who cannot be relied upon to do that will need to be isolated from the public places.

REPORT OF THE BOARD OF CATTLE COMMISSIONERS.

CONCORD, January 1, 1895.

To His Excellency the Governor:

The State Board of Cattle Commissioners has continued its work during the year upon the lines contemplated by the Public Statutes, and submits the following brief report for the period from January 1, 1894, to January 1, 1895. The law under which this work has been performed was enacted for the special purpose of suppressing bovine tuberculosis, yet included in its scope other contagious and infectious diseases of animals. While the law confers upon the board all necessary authority for the most vigorous and thorough inspection of the live stock of the state, and power to issue any regulations that may be essential to the control of disease, the funds for carrying its provisions into effect are insufficient to make any general or systematic inspection. In view of this fact, the board has only been able to give attention to such cases as have been reported by the owners of stock, or the selectmen of towns, as manifesting evidences of disease. Attention has been given to every such notification, and when the circumstances warranted an investigation, it has been made. This has apparently met the approval of those receiving the service, but has come far short of meeting the demand for inspection of herds in the interest of public health. The prevalence of the disease and the wisdom of vigorous action for its suppression, seems to demand more extensive and exhaustive investigation than the present funds allow. It remains for the legislature to determine by its appropriation for this purpose to what extent this work shall be carried.

From January 1, 1894, to January 1, 1895, 383 stables have been inspected, from which 293 cattle have been condemned and destroyed, located in the counties as follows:

	Herds Inspected.	Cattle Destroyed.
Belknap,	6	5
Carroll,		
Cheshire,	65	32
Coös,	12	2
Grafton,	12	10
Hillsborough,	185	173
Merrimack,	50	33
Rockingham,	38	24
Strafford,	14	14
Sullivan,	1	

A post-mortem examination of all cattle killed has been made, and the errors of diagnosis have been so slight as to be of no consequence. According to the law, cattle condemned have been appraised upon a basis of health, and the owners have received one half of said appraisal. The average amount paid by the state for these cattle has been $14.92 per head.

During the year 24 horses have been condemned with glanders and destroyed.

From April 15, 1891, to January 1, 1895, there have been condemned and destroyed 607 cattle having tuberculosis, located in the counties as follows:

Belknap,	11
Carroll,	1
Cheshire,	43
Coös,	4
Grafton,	14
Hillsborough,	359
Merrimack,	92
Rockingham,	52
Strafford,	27
Sullivan,	4

No more effort has been made to discover the disease in one county than any other, as all investigations have been made upon the request of owners or selectmen. It is therefore not unreasonable to suppose that the disease exists in the various counties about in the relative proportion of cases found. The tuberculin test has

been used extensively in diagnosis of the disease, and, although not infallible, no error has yet been found from its use. The board now depends entirely upon it as a diagnostic agent. It is recommended by the best expert authorities, and is regarded as free from all harmful results.

The quarantine regulations previously established against Massachusetts cattle are still in force, and have been supplemented by similar regulations by Massachusetts authorities against New Hampshire cattle. It is quite probable that these can be raised when similar action shall have been taken by both states for the suppression of tuberculosis. In the opinion of the commission this matter should receive the most careful consideration of the legislature, and the adjustment of values of tuberculous cattle destroyed should be made with due regard for the personal safety of citizens as well as the property rights of stock owners.

The most eminent authorities substantiate the claim that no backward step in legislative action should be taken in suppressing this disease.

Respectfully submitted,

IRVING A. WATSON,
President.

N. J. BACHELDER,
Secretary.

TYPHOID FEVER IN NEW HAMPSHIRE.

Typhoid fever is preëminently a preventable disease, yet during the past eleven years, from 1883 to 1893 inclusive, there have been officially reported to the registrar of vital statistics, 1,736 deaths from this disease in New Hampshire. These figures probably do not represent all the deaths that have occurred during the period named, inasmuch as in the earlier years included in this calculation the registration of the causes of death was not as accurate as during the latter part of the period. It is therefore quite certain that the actual mortality is somewhat in excess of the figures given. It is estimated by careful investigations that for every fatal case of typhoid fever there are, upon the average, ten non-fatal cases. We may, therefore, reasonably conclude that in the eleven years past there have been over 17,000 cases of this disease in this state.

In Table No. 1 will be found a record of the total number of deaths reported by towns from 1883 to 1893 inclusive, also the number of reported deaths from typhoid fever by towns for the period named.

The object of this table is to place upon record, in as concise a manner as possible, the mortality for the period given, and also to show the number of deaths returned from typhoid fever, and the distribution of this disease both by localities and years. This table may not accurately represent the distribution of typhoid fever, inasmuch as the disease doubtless has prevailed in some towns in certain years without fatal results, and hence would not be represented in the table.

The table also represents the percentage of mortality from typhoid fever to the total mortality for the eleven years mentioned.

TABLE No. 1.

Showing total mortality and typhoid fever mortality by counties and towns from 1883 to 1893 inclusive.

ROCKINGHAM COUNTY.		1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	Total.	Percentage.
Atkinson	Total mortality	8	8	5	12	9	10	11	10	2	22	5	102	
	Typhoid fever							1					2	1.96
Auburn	Total mortality	12	23	8	9	7	12	19	10	15	10	15	140	
	Typhoid fever	1			1					1	1		4	2.85
Brentwood	Total mortality	50	34	39	26	32	14	36	28	28	30	45	362	
	Typhoid fever	2		1					1	1		1	6	1.65
Candia	Total mortality	12	15	30	24	28	20	21	13	27	31	23	244	
	Typhoid fever							1		1	1		3	1.23
Chester	Total mortality	30	17	17	20	19	15	21	20	24	17	15	215	
	Typhoid fever	3	1			1		1	1	1	1	1	10	4.65
Danville	Total mortality		6	10	15	11	8	6	13	8	10	13	100	
	Typhoid fever				1	1							2	2.00
Deerfield	Total mortality	28	30	31	29	25	40	29	30	35	33	24	334	
	Typhoid fever				2		1	1					4	1.19
Derry	Total mortality	31	38	44	39	37	46	34	44	42	47	56	458	
	Typhoid fever		3	3	4	1		5		4			20	4.36
East Kingston	Total mortality	5	10	9	15	7	8	16	11	13	15	11	120	
	Typhoid fever			1						1			2	1.66
Epping	Total mortality	23	26	40	37	25	39	39	45	53	48	46	421	
	Typhoid fever	2			2				2	2			8	1.90
Exeter	Total mortality	40	47	50	67	60	75	66	85	61	80	99	730	
	Typhoid fever	1	1	1	1			3	1	1	1		10	1.37
Fremont	Total mortality	7	9	10	9	11	15	10	19	7	19	8	124	
	Typhoid fever													

TABLE No. 1.—*Continued.*

ROCKINGHAM COUNTY.		1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	Total.	Percentage.
Greenland	Total mortality	11	12	11	12	14	9	12	18	15	9	16	139	
	Typhoid fever	1				1	1		1	1			5	3.59
Hampstead	Total mortality	6	20	15	11	9	13	15	17	14	12	11	143	
	Typhoid fever		1	1								1	3	2.09
Hampton	Total mortality	14	32	19	13	16	19	14	33	32	11	11	214	
	Typhoid fever						1	1	2		2		6	2.80
Hampton Falls	Total mortality	12	14	7	12	13	12	5	9	6	11	6	107	
	Typhoid fever	2	1										3	2.80
Kensington	Total mortality	2	7	13	10	12	6	10	10	10	10	7	97	
	Typhoid fever			1						1			2	2.05
Kingston	Total mortality	13	19	21	20	15	25	25	37	13	10	22	220	
	Typhoid fever						1						1	.45
Londonderry	Total mortality	17	10	20	21	20	15	14	23	29	32	32	233	
	Typhoid fever				1							1	2	.85
Newcastle	Total mortality	7	11	7	7	7	5	13	10	4	10	8	89	
	Typhoid fever													
Newington	Total mortality	6	8	9	7	8	9	8	6	12	7	6	86	
	Typhoid fever						1						1	1.16
Newmarket	Total mortality	23	37	59	90	64	64	62	55	66	71	59	650	
	Typhoid fever	1	3					1	1	2		1	9	1.38
Newton	Total mortality	5	13	15	22	33	27	16	26	21	25	17	220	
	Typhoid fever		1	1			2		1	3			8	3.64
North Hampton	Total mortality	6	8	11	6	2	5	10	7	13	9	9	86	
	Typhoid fever										1		1	1.16

Northwood	Total mortality	16	16	23	24	19	23	21	29	30	24	27	252	
	Typhoid fever	1			2					2	1	1	7	2.78
Nottingham	Total mortality	8	18	14	19	23	16	18	28	9	23	18	194	
	Typhoid fever													
Plaistow	Total mortality	17	16	9	19	6	13	10	17	20	11	22	171	
	Typhoid fever	1	1	2	2					1			7	4.09
Portsmouth	Total mortality	156	217	238	213	170	196	194	258	208	210	238	2,298	
	Typhoid fever	6	5	4	3	3	1	1	1	3	2	1	30	1.31
Raymond	Total mortality	13	21	16	21	31	16	18	14	18	21	25	214	
	Typhoid fever			2	1					1	1		5	2.33
Rye	Total mortality	8	23	19	22	21	19	16	11	15	14	17	185	
	Typhoid fever		1		2	1	1				1		6	3.24
Salem	Total mortality	28	24	26	35	25	29	19	32	37	42	36	333	
	Typhoid fever		1	1		1				2	1		6	1.80
Sandown	Total mortality	7	12	8	8	8	11	6	7	5	7	11	90	
	Typhoid fever	1			1								2	2.22
Seabrook	Total mortality	36	30	21	23	25	16	23	43	40	42	33	332	
	Typhoid fever		1						1	1			3	.90
South Hampton	Total mortality	7	8	8	7	6	7	4	9	10	9	6	81	
	Typhoid fever		2										2	2.47
South Newmarket	Total mortality	14	14	9	19	17	18	11	15	17	18	15	167	
	Typhoid fever				1						1		2	1.19
Stratham	Total mortality	13	8	6	11	12	11	10	9	11	17	7	115	
	Typhoid fever										2		2	1.74
Windham	Total mortality	8	12	14	9	19	10	13	14	21	9	14	143	
	Typhoid fever	1				1				1	1	1	5	3.49

TABLE No. 1.—*Continued.*

STRAFFORD COUNTY.		1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	Total.	Percentage.
Barrington	Total mortality	27	16	17	22	34	18	22	23	17	37	23	256	
	Typhoid fever	1		1			1		1			1	5	1.95
Dover	Total mortality	205	253	303	222	255	283	252	317	308	331	330	3,059	
	Typhoid fever	4	4	7	1	8	2	2	3	2	5	5	43	1.41
Durham	Total mortality	19	3	6	11	11	11	12	16	19	27	10	145	
	Typhoid fever							3	1				4	2.76
Farmington	Total mortality	39	54	62	44	34	52	55	61	52	63	40	556	
	Typhoid fever			1	1	1	2	1	3		1		10	1.79
Lee	Total mortality	15	5	10	7	14	15	6	6	13	12	12	115	
	Typhoid fever				1								1	.87
Madbury	Total mortality	1	11	6	5	3	3	4	4	7	9	4	57	
	Typhoid fever		1										1	1.75
Middleton	Total mortality	4	4	1	1	4	3	9	5	11	5	3	50	
	Typhoid fever													
Milton	Total mortality	9	26	16	10	11	7	17	23	30	22	23	194	
	Typhoid fever					1				1	1		3	1.54
New Durham	Total mortality	5	7	10	14	16	12	18	16	13	14	9	134	
	Typhoid fever	1					2						3	2.24
Rochester	Total mortality	52	106	57	96	111	112	104	116	144	134	113	1,145	
	Typhoid fever	1	1	1	4	2		3	1	5		3	21	1.83
Rollinsford	Total mortality	18	16	24	21	20	24	27	26	30	47	34	287	
	Typhoid fever	1			1				1		1	1	5	1.74
Somersworth	Total mortality	78	106	92	125	127	127	139	162	143	137	125	1,361	
	Typhoid fever	4	8	2	12	3	5	9	7	4	3	7	64	4.70
Strafford	Total mortality	22	20	15	31	33	21	26	26	22	26	16	258	
	Typhoid fever	2			2	3	1	1	2			3	14	5.43

TABLE No. 1.—*Continued.*

BELKNAP COUNTY.		1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	Total.	Percentage.
Alton	Total mortality	30	26	17	22	26	23	37	32	26	33	26	298	
	Typhoid fever	1			1	1		1	2				6	2.01
Barnstead	Total mortality	24	21	11	12	16	15	28	21	29	26	18	221	
	Typhoid fever		2		1	1			1				5	2.26
Belmont	Total mortality	22	25	27	22	17	42	21	20	19	34	20	269	
	Typhoid fever	1			2				1		2		6	2.23
Centre Harbor	Total mortality	5	9	5	10	5	8	3	8	7	8	6	74	
	Typhoid fever													
Gilford	Total mortality	48	41	48	62	75	54	53	55	59	68	6	569	
	Typhoid fever	2	1	2	11	2	4		4	1			27	4.74
Gilmanton	Total mortality	30	25	27	18	20	25	20	21	15	34	26	261	
	Typhoid fever	1				1							2	.76
Laconia	Total mortality	52	58	78	111	117	127	116	98	163	129	174	1,223	
	Typhoid fever		2		7	6	2	6	3	1	1	4	32	2.62
Meredith	Total mortality	12	31	26	30	41	36	34	30	23	32	24	319	
	Typhoid fever	1	3	1		1					1		7	2.19
New Hampton	Total mortality	8	13	11	15	15	20	21	25	11	25	21	185	
	Typhoid fever				1			1	1				3	1.62
Sanbornton	Total mortality	22	22	19	28	15	20	24	30	20	23	20	243	
	Typhoid fever		1	1	4					1			7	2.88
Tilton	Total mortality	9	14	20	32	22	22	32	34	20	28	28	261	
	Typhoid fever	2	5	5	6	1	2	1	1	2			25	9.57

TABLE No. 1.—*Continued.*

CARROLL COUNTY.		1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	Total.	Percentage.
Albany	Total mortality	3	.....	4	4	2	3	3	5	1	3	5	33	.....
	Typhoid fever	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Bartlett	Total mortality	6	13	14	12	13	15	17	13	20	22	24	169	.....
	Typhoid fever	.....	.....	5	.....	.....	.....	.....	.....	.....	.....	.....	5	2.96
Brookfield	Total mortality	15	7	5	7	7	4	13	3	3	4	6	73	.....
	Typhoid fever	.....	.....	1	.....	.....	.....	.....	1	.....	.....	.....	2	2.77
Chatham	Total mortality	9	14	4	2	4	6	3	6	8	4	2	62	.....
	Typhoid fever	.....	.....	.....	.....	.....	1	.....	1	.....	.....	.....	2	3.23
Conway	Total mortality	20	33	33	33	25	33	41	30	48	49	42	387	.....
	Typhoid fever	.....	1	1	1	3	1	1	.....	.....	1	1	10	2.58
Eaton	Total mortality	5	5	7	6	8	8	4	8	4	4	8	67	.....
	Typhoid fever	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Effingham	Total mortality	12	18	15	11	17	14	17	13	15	16	13	161	.....
	Typhoid fever	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1	.62
Freedom	Total mortality	4	4	8	11	7	13	7	18	10	12	9	103	.....
	Typhoid fever	1	1	.....	.....	.....	.....	1	.....	.....	.....	.....	3	2.91
Hart's Location	Total mortality	.....	.....	.....	.....	.....	.....	.....	2	2	3	1	8	.....
	Typhoid fever	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Jackson	Total mortality	6	4	2	5	4	4	6	5	15	8	4	63	.....
	Typhoid fever	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	1	1.59
Madison	Total mortality	5	12	10	7	16	11	7	11	12	6	16	113	.....
	Typhoid fever	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Moultonborough	Total mortality	20	22	27	24	15	29	17	27	19	19	21	240	1.25
	Typhoid fever	1	.....	1	1	.....	.....	.....	.....	.....	.....	.....	3	.....

Ossipee	Total mortality	39	39	32	51	32	44	27	34	44	36	26	404	
	Typhoid fever		1			1	1						3	.74
Sandwich	Total mortality	32	43	24	20	29	39	29	26	32	29	30	333	
	Typhoid fever	3					1	1					5	1.50
Tamworth	Total mortality	6	23	14	24	19	20	17	15	27	18	10	193	
	Typhoid fever						1						1	.52
Tuftonborough	Total mortality	17	22	17	17	14	16	24	12	15	26	17	197	
	Typhoid fever	1						1			1		3	1.52
Wakefield	Total mortality	24	19	15	18	27	14	22	34	27	34	23	257	
	Typhoid fever	1						3		2			6	2.33
Wolfeborough	Total mortality	30	55	38	51	55	55	44	42	39	49	48	506	
	Typhoid fever		2		1	1	1						5	.99

TABLE No. 1.—*Continued.*

MERRIMACK COUNTY.		1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	Total.	Percentage.
Allenstown	Total mortality	22	8	11	18	13	18	11	27	23	27	36	214	
	Typhoid fever	3				1		1	4				9	4.21
Andover	Total mortality	16	13	25	23	13	15	20	12	24	21	22	204	
	Typhoid fever				1			1					2	.98
Boscawen	Total mortality	39	24	21	27	42	51	49	47	48	39	42	429	
	Typhoid fever			1		1	1	1		1			5	1.18
Bow	Total mortality	12	12	16	11	13	13	9	12	4	19	21	142	
	Typhoid fever													
Bradford	Total mortality	15	17	14	25	20	19	15	15	20	16	25	201	
	Typhoid fever	1	1					1					3	1.49
Canterbury	Total mortality	11	15	20	12	11	20	17	18	19	25	20	188	
	Typhoid fever		1					1			1		3	1.59
Chichester	Total mortality	4	14	10	16	7	18	7	11	17	10	7	121	
	Typhoid fever			1								1	2	1.65
Concord	Total mortality	289	277	264	279	307	342	336	372	344	415	437	3,662	
	Typhoid fever	11	4	4	6	7	13	6	9	5	2	2	69	1.88
Danbury	Total mortality	11	5	11	13	13	16	17	15	9	13	11	134	
	Typhoid fever			1	2		3		1		1		8	5.97
Dunbarton	Total mortality	15	12	8	6	14	14	8	10	9	13	10	119	
	Typhoid fever													
Epsom	Total mortality	9	17	11	18	24	7	11	14	11	15	14	151	
	Typhoid fever		3										3	1.99
Franklin	Total mortality	59	52	56	55	74	76	55	70	63	77	62	699	
	Typhoid fever	3	1	3	3	3	3	2	4		3	2	27	3.86
Henniker	Total mortality	21	33	28	24	24	17	26	34	24	27	23	281	
	Typhoid fever	2					1		1				4	1.42

Hill	Total mortality	14	10	7	14	12	15	12	6	6	14	10	120	
	Typhoid fever			1	2		1						4	3.33
Hooksett	Total mortality	25	16	16	21	24	38	30	24	29	34	39	296	
	Typhoid fever		1				4	3	1			2	11	3.71
Hopkinton	Total mortality	50	31	45	46	36	27	33	37	36	50	28	424	
	Typhoid fever	1	1	1							1	1	5	1.18
Loudon	Total mortality	12	20	25	31	24	18	26	26	30	10	19	241	
	Typhoid fever	1	2	1	2								6	2.49
Newbury	Total mortality	12	7	12	10	7	15	7	2	15	10	8	105	
	Typhoid fever					1	1						2	1.90
New London	Total mortality	11	11	9	8	11	18	7	21	14	4	16	130	
	Typhoid fever	2											2	1.54
Northfield	Total mortality	4	8	8	11	13	23	17	19	15	23	22	163	
	Typhoid fever				1	1		1				1	4	2.46
Pembroke	Total mortality	26	24	29	43	28	30	26	55	50	67	63	441	
	Typhoid fever	1	2	1	3		2	1	6	5	1	1	23	5.21
Pittsfield	Total mortality	18	39	49	43	42	48	55	50	36	49	40	469	
	Typhoid fever		1		1		2	1	1	1	1	2	10	2.13
Salisbury	Total mortality	8	6	13	13	9	14	16	9	23	13	13	137	
	Typhoid fever									3			3	2.19
Sutton	Total mortality	16	16	22	12	16	13	18	23	25	17	19	197	
	Typhoid fever	2											2	1.02
Warner	Total mortality	24	19	30	30	21	12	26	30	35	29	34	290	
	Typhoid fever					1	2	1			1	1	6	2.07
Webster	Total mortality	9	8	20	12	8	10	16	4	8	12	5	112	
	Typhoid fever				3			2					5	4.46
Wilmot	Total mortality	10	22	16	12	9	13	15	20	14	15	17	163	
	Typhoid fever			1			1			1			3	1.84

TABLE No. 1.—*Continued.*

HILLSBOROUGH COUNTY.		1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	Total.	Percentage.
Amherst	Total mortality	15	29	16	18	26	16	21	24	22	19	36	242	
	Typhoid fever				2					1			3	1.24
Antrim	Total mortality	21	25	25	32	13	16	11	27	18	29	31	248	
	Typhoid fever	2	1	1		1					1		6	2.42
Bedford	Total mortality	8	7	22	29	26	20	16	13	24	25	31	221	
	Typhoid fever	2	1	1	1	2	1	1				1	10	4.52
Bennington	Total mortality	25	9	9	11	9	9	13	11	14	12	8	130	
	Typhoid fever		1	2					1			1	5	3.84
Brookline	Total mortality	20	11	13	16	15	5	16	14	9	10	9	138	
	Typhoid fever	2											2	1.45
Deering	Total mortality	8	6	14	8	12	9	11	20	5	13	12	118	
	Typhoid fever	1	1								1		3	2.54
Francestown	Total mortality	15	13	9	12	11	22	22	15	17	13	12	161	
	Typhoid fever				1			2	2	1		1	7	4.35
Goffstown	Total mortality	20	29	35	27	23	36	31	34	36	35	21	327	
	Typhoid fever						1	1					2	.61
Greenfield	Total mortality	19	5	19	14	12	14	16	9	11	9	12	140	
	Typhoid fever						1						1	.71
Greenville	Total mortality	20	18	20	22	21	31	30	26	22	40	34	284	
	Typhoid fever				1		2	5	2	1	2	1	14	4.93
Hancock	Total mortality	11	16	15	15	16	11	11	14	14	10	19	152	
	Typhoid fever													
Hillsborough	Total mortality	29	21	13	22	43	49	20	40	40	45	45	367	
	Typhoid fever			1	2	1	3	1					8	2.18

Hollis	Total mortality	1	17	22	25	21	12	11	28	21	20	15	193	
	Typhoid fever													
Hudson	Total mortality	16	13	18	17	17	22	18	23	23	23	27	217	
	Typhoid fever		1			2			1				4	1.84
Litchfield	Total mortality	3	4	5	3	5	10	3	6	6	4	4	53	
	Typhoid fever													
Lyndeborough	Total mortality	9	17	7	17	11	13	14	13	12	17	16	146	
	Typhoid fever		2				1		1				4	2.73
Manchester	Total mortality	779	819	821	786	862	929	838	1,030	942	1,038	1,071	9,915	
	Typhoid fever	21	17	23	18	21	17	22	17	23	6	14	199	2.01
Mason	Total mortality	7	7	11	14	7	8	12	10	11	11	11	109	
	Typhoid fever		1										1	.92
Merrimack	Total mortality	12	17	10	16	17	16	20	10	16	22	16	172	
	Typhoid fever					1							1	.58
Milford	Total mortality	52	51	43	52	50	47	50	43	50	60	56	554	
	Typhoid fever			1				3	5	1			10	1.81
Mont Vernon	Total mortality	12	7	12	4	10	6	3	5	13	4	5	81	
	Typhoid fever						1	1					2	2.47
Nashua	Total mortality	277	306	343	424	276	329	347	346	408	402	390	3,848	
	Typhoid fever	3	3	8	10	17	15	4	3	15	7	6	91	2.36
New Boston	Total mortality	24	21	23	22	22	17	21	16	15	24	23	228	
	Typhoid fever				1								1	.44
New Ipswich	Total mortality	30	20	17	24	21	22	21	30	19	24	12	240	
	Typhoid fever		1		3								4	1.66
Pelham	Total mortality	14	11	22	15	10	10	11	13	14	24	24	168	
	Typhoid fever	2	1		1					2			6	3.57
Peterborough	Total mortality	41	47	43	48	44	49	50	50	51	46	42	511	
	Typhoid fever	1	1	1	2	2			2	1			10	1.95
Sharon	Total mortality	3	2	3	1	5	1	2	3	2	1	2	25	
	Typhoid fever													

TABLE No. 1.—*Continued.*

HILLSBOROUGH COUNTY.—*Continued.*		1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	Total.	Percentage.
Temple	Total mortality	11	5	8	9	4	6	3	4	8	6	5	69	
	Typhoid fever				2				1	1			4	5.79
Weare	Total mortality	34	27	43	32	24	36	30	26	38	30	34	354	
	Typhoid fever	1	2		1	1			1	1		1	8	2.26
Wilton	Total mortality	15	73	20	56	61	75	67	66	74	74	78	659	
	Typhoid fever		1		3		2	2	2	2		1	13	1.97
Windsor	Total mortality		2			3		1	4	2	2	2	16	
	Typhoid fever										2		2	1.25

TABLE No. 1.—*Continued.*

CHESHIRE COUNTY.		1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	Total.	Percentage.
Alstead	Total mortality	9	14	15	19	25	13	16	26	15	18	16	186	
	Typhoid fever			1	1								2	1.06
Chesterfield	Total mortality	11	21	17	10	17	23	18	17	19	14	18	135	
	Typhoid fever		1				1	1					3	2.22
Dublin	Total mortality	5	9	16	7	6	5	12	7	5	10	5	87	
	Typhoid fever							1					1	1.15
Fitzwilliam	Total mortality	19	19	15	16	23	28	22	19	18	26	30	235	
	Typhoid fever		1			1							2	.85
Gilsum	Total mortality	16	16	13	14	12	10	9	8	17	8	8	131	
	Typhoid fever	1				1				1	1		4	3.05
Harrisville	Total mortality	25	9	15	9	9	6	9	13	4	10	12	121	
	Typhoid fever	2		1							1	1	5	4.13
Hinsdale	Total mortality	25	21	29	40	24	21	29	27	25	39	42	322	
	Typhoid fever		1	2	1	1		4	1				10	3.11
Jaffrey	Total mortality	31	30	28	25	28	23	23	39	28	26	31	312	
	Typhoid fever	2		1					1	1			5	1.60
Keene	Total mortality	136	125	114	125	132	83	135	156	126	138	159	1,429	
	Typhoid fever	3	3	4	3		2	1	1		2	3	22	1.54
Marlborough	Total mortality	11	22	31	29	25	15	24	21	20	33	41	272	
	Typhoid fever				2				1	1			4	1.47
Marlow	Total mortality	4	14	12	11	7	8	14	8	15	17	13	123	
	Typhoid fever		1										1	.81
Nelson	Total mortality	8	5	6	5	1	4	7	11	2	2	5	56	
	Typhoid fever	1											1	1.79

TABLE No. 1.—*Continued.*

CHESHIRE COUNTY.—*Continued.*		1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	Total.	Percentage.
Richmond	Total mortality	8	16	15	14	14	14	13	9	13	14	14	144	
	Typhoid fever		3	1	3				1		1		9	6.25
Rindge	Total mortality	15	20	8	23	13	17	29	24	17	20	25	211	
	Typhoid fever			1				1	2	2	1		7	3.31
Roxbury	Total mortality	1	2			2		2	2	1	6	3	19	
	Typhoid fever													
Stoddard	Total mortality	4	13	14	5	5	6	10	6	9	11	11	94	
	Typhoid fever										1		1	1.06
Sullivan	Total mortality	3	4	4	4	2	2	9	3	6	4	2	43	
	Typhoid fever									1			1	2.33
Surry	Total mortality	7	1	4	5	6	6	4	5	4	6	3	51	
	Typhoid fever	1											1	1.96
Swanzey	Total mortality	17	23	28	21	34	29	29	33	24	39	35	312	
	Typhoid fever		2	2	1		2	1		2	1		11	3.52
Troy	Total mortality	10	20	12	12	8	5	10	14	14	31	16	152	
	Typhoid fever		1										1	.65
Walpole	Total mortality	26	40	30	30	38	32	32	53	39	64	39	423	
	Typhoid fever	1							1			1	3	.71
Westmoreland	Total mortality	14	20	28	15	24	12	33	25	31	30	29	261	
	Typhoid fever		1						2			1	4	1.53
Winchester	Total mortality	13	33	40	36	27	28	36	31	30	42	38	354	
	Typhoid fever		2	2	2	3	1	2		1	1		14	3.95

TABLE No. 1.—*Continued.*

SULLIVAN COUNTY.		1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	Total.	Percentage.
Acworth	Total mortality	18	14	19	19	15	26	19	10	17	15	19	191	
	Typhoid fever	1											1	.52
Charlestown	Total mortality	13	23	23	31	12	26	26	39	23	34	35	285	
	Typhoid fever				2			1				1	4	1.40
Claremont	Total mortality	73	82	49	88	84	97	94	102	74	103	101	947	
	Typhoid fever	3	3	1		3	2	2		1	2	1	18	1.90
Cornish	Total mortality	13	8	21	12	17	17	19	17	20	22	21	187	
	Typhoid fever			1	1						1	1	4	2.14
Croydon	Total mortality	20	7	13	9	5	10	10	16	8	11	11	120	
	Typhoid fever				1								1	.83
Goshen	Total mortality	10	9	10	10	10	12	9	5	7	8	9	99	
	Typhoid fever	2											2	2.02
Grantham	Total mortality	7	5	5	7	8	7	8	10	6	16	8	87	
	Typhoid fever	1	1							1			3	3.45
Langdon	Total mortality	5	10		10	2	4	5	11	7	6	8	68	
	Typhoid fever		1						1				2	2.94
Lempster	Total mortality	9	4	4	13	7	11	14	11	7	9	13	102	
	Typhoid fever													
Newport	Total mortality	38	36	21	45	45	46	46	45	43	80	66	511	
	Typhoid fever			1	2	1	1	1			5	4	15	2.93
Plainfield	Total mortality	11	22	19	24	18	12	13	12	8	14	21	174	
	Typhoid fever	2		1						1		1	5	2.89
Springfield	Total mortality	6	12	3	8	9	12	13	13	12	17	15	120	
	Typhoid fever													

TABLE No. 1.—*Continued.*

SULLIVAN COUNTY.—*Continued.*		1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	Total.	Percentage.
Sunapee	Total mortality	15	13	6	17	20	9	14	12	16	15	19	156	.....
	Typhoid fever.	3	.....	.....	.....	1	.....	.....	.....	2	.....	.....	6	3.84
Unity	Total mortality	13	12	19	19	22	21	18	21	21	19	10	195	.....
	Typhoid fever	.....	.....	.....	.....	.....	.....	.....	.....	1	1	.....	2	1.02
Washington	Total mortality	3	16	13	16	9	18	6	8	11	13	6	119	.....
	Typhoid fever	1	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	2	1.68

TABLE No. 1.—*Continued.*

GRAFTON COUNTY.		1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	Total.	Percentage.
Alexandria	Total mortality	5	10	3	12	18	14	11	21	8	21	14	137	
	Typhoid fever								1				1	.73
Ashland	Total mortality	3	2	13	12	10	20	16	19	21	27	21	164	
	Typhoid fever		1								1		2	1.22
Bath	Total mortality	12	13	8	15	15	16	15	10	13	8	16	141	
	Typhoid fever	2	2	1	2					2			9	6.38
Benton	Total mortality		2		2	2	2	5	5	5	7	7	37	
	Typhoid fever							1	1				2	5.41
Bethlehem	Total mortality	15	13	16	19	18	9	18	25	16	13	26	188	
	Typhoid fever	1	1	1					1	2			6	3.19
Bridgewater	Total mortality	3	8	10	11	4	6	6	8	4	12	5	77	
	Typhoid fever				1							1	2	2.59
Bristol	Total mortality	10	39	24	28	30	31	35	28	30	28	27	310	
	Typhoid fever	1				1	4	5	1	3		1	16	5.16
Campton	Total mortality	17	13	15	20	21	13	25	17	16	18	21	196	
	Typhoid fever	1				1	1		1				4	2.04
Canaan	Total mortality	14	19	35	34	22	26	27	25	20	36	42	300	
	Typhoid fever			1	2		3	1	1		1		9	3.00
Dorchester	Total mortality	7	6	6	4	5	8	7	10	6		5	64	
	Typhoid fever				1	1	1		1	1			5	7.81
Easton	Total mortality	7	6	5	5	3	5	2	9	2	3	4	51	
	Typhoid fever	1											1	1.96
Ellsworth	Total mortality	3	2	7	1	2	1	5	2	1	4	2	30	
	Typhoid fever													

TABLE No. 1.—*Continued.*

GRAFTON COUNTY.—*Continued.*		1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	Total.	Percentage.
Enfield	Total mortality	29	33	27	31	35	27	27	20	24	39	21	313	
	Typhoid fever	1	1		1				1		1	1	6	1.92
Franconia	Total mortality	7	11	7	7	6	15	11	11	9	6	7	97	
	Typhoid fever	1	1							2			4	4.12
Grafton	Total mortality	12	26	17	15	14	15	17	5	20	28	18	187	
	Typhoid fever		1			1			1				3	1.60
Groton	Total mortality	5	8	12	15	7	7	5	13	6	21	6	105	
	Typhoid fever					1							1	.95
Hanover	Total mortality	22	36	27	31	31	29	39	25	31	27	33	331	
	Typhoid fever	2	1						1	2			6	1.81
Haverhill	Total mortality	55	36	46	36	43	26	40	62	71	57	59	531	
	Typhoid fever	3	2		3		1	3	2	2		6	22	4.14
Hebron	Total mortality	4	7	3	6	8	7	8	4	5	6	4	62	
	Typhoid fever					1				1			2	3.23
Holderness	Total mortality	10	14	11	14	18	11	9	12	10	17	9	135	
	Typhoid fever	1		1	2		1						5	3.70
Landaff	Total mortality	4	5	9	5	13	9	9	12	11	8	10	95	
	Typhoid fever		1										1	1.05
Lebanon	Total mortality	46	51	66	48	46	58	37	73	51	91	77	644	
	Typhoid fever				1		1	1		2	2		7	1.09
Lincoln	Total mortality	2			1	2	1	1			2	8	17	
	Typhoid fever	1										1	2	11.76
Lisbon	Total mortality	27	28	21	31	28	35	25	32	44	39	40	350	
	Typhoid fever		1		2			1					4	1.14

Littleton	Total mortality	56	55	50	49	47	49	46	46	57	74	61	590	
	Typhoid fever		2	2			1			1	2	3	11	1.86
Livermore	Total mortality	1	2				3					1	7	
	Typhoid fever													
Lyman	Total mortality	19	9	9	13	6	10	14	6	17	7	7	117	
	Typhoid fever	1					1	1					3	2.56
Lyme	Total mortality	19	40	18	18	29	23	27	28	28	23	26	279	
	Typhoid fever			1		1	1						3	1.07
Monroe	Total mortality	7	9	7	4	9	18	8	7	6	10	6	91	
	Typhoid fever	1	1	1		1							4	4.39
Orange	Total mortality	3	6	4	4	2	7	3	3	1	4	4	41	
	Typhoid fever				1								1	2.44
Orford	Total mortality	19	21	15	19	10	27	29	18	21	21	16	216	
	Typhoid fever	1			2					1			4	1.85
Piermont	Total mortality	13	14	17	20	11	9	7	11	7	9	7	125	
	Typhoid fever				2								2	1.60
Plymouth	Total mortality	12	34	34	29	22	36	21	22	26	32	26	294	
	Typhoid fever						2			2	1	1	6	2.04
Rumney	Total mortality	21	13	21	11	19	22	22	23	22	20	15	209	
	Typhoid fever			1				2	1	2		1	7	3.35
Thornton	Total mortality	8	12	9	18	16	16	12	7	12	8	15	133	
	Typhoid fever	2					1					1	4	3.01
Warren	Total mortality	14	14	11	6	11	17	10	7	12	9	13	124	
	Typhoid fever			1	1	1	2	1					6	4.84
Waterville	Total mortality			1		1				1		1	4	
	Typhoid fever													
Wentworth	Total mortality	10	18	24	19	14	16	17	17	9	7	10	161	
	Typhoid fever		1				1		1				3	1.86
Woodstock	Total mortality	5	2	4	3	4	11	9	8	5	7	6	64	
	Typhoid fever	1											1	1.56

TABLE No. 1.—*Continued.*

COÖS COUNTY.		1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	Total.	Percentage.
Berlin	Total mortality	13	33	19	17	109	46	79	41	141	105	143	746	
	Typhoid fever	1				8	5	1	1	8	7	7	38	5.09
Carroll	Total mortality	11	6		5	13	12	13	18	11	10	6	105	
	Typhoid fever							1					1	.95
Clarksville	Total mortality	3	2	2	2	2	2	5	5	5	7	6	41	
	Tpphoid fever		1					1			1		3	7.32
Colebrook	Total mortality	12	30	25	28	28	26	24	27	35	34	22	291	
	Typhoid fever	2	1	3		2	1	4			2		15	5.15
Columbia	Total mortality	6	6	9	7	5	11	10	9	9	6	9	87	
	Typhoid fever													
Dalton	Total mortality	7	8	9	2	9	8	11	12	7	8	7	88	
	Typhoid fever		1										1	1.14
Dummer	Total mortality	2	2	3	5	2	4	4	3	1	5	1	32	
	Typhoid fever	1			1						1	1	4	12.50
Errol	Total mortality	3	1	3	1	2	1	2	2	6	2		23	
	Typhoid fever							1			1		2	8.69
Gorham	Total mortality	16	7	14	6	26	10	7	23	13	32	12	166	
	Typhoid fever				1		1	1	1		3	1	8	4.82
Jefferson	Total mortality	5	9	13	14	14	12	11	14	22	20	12	146	
	Typhoid fever					2	1		2			1	6	4.11
Lancaster	Total mortality	30	29	33	57	47	48	36	46	65	48	40	479	
	Typhoid fever			1					1		3	2	7	1.46
Milan	Total mortality	8	15	8	7	9	11	14	17	11	17	6	123	
	Typhoid fever	1	1		1		1		1				5	4.06

Millsfield	Total mortality				1					2			3	
	Typhoid fever													
Northumberland	Total mortality	5	18	10	15	18	28	22	14	28	20	25	203	
	Typhoid fever	1	1		1		1	1		1	1	1	8	3.94
Pittsburg	Total mortality	4	2	5	7	5	5	7	8	10	5	14	72	
	Typhoid fever			1						1		2	4	5.50
Randolph	Total mortality	3	2	2	1	1	5	2		2	6	2	26	
	Typhoid fever						1						1	3.84
Shelburne	Total mortality	2	2	5	2		4	5		2	1	2	25	
	Typhoid fever													
Stark	Total mortality	8	10	9	7	7	5	12	12	10	16	8	104	
	Typhoid fever	2	2	2			1				1		8	7.69
Stratford	Total mortality	8	21	11	18	9	23	20	20	14	25	28	197	
	Typhoid fever		1	1	3		1	1	1		1	1	10	5.07
Stewartstown	Total mortality	9	29	17	14	11	18	18	12	23	15	23	189	
	Typhoid fever		3			2				1			6	3.17
Whitefield	Total mortality	26	31	30	40	27	35	45	46	42	33	29	389	
	Typhoid fever	1	3		1	2	1						8	2.06

Table No. 2 consists of diagrams showing the relative mortality from typhoid fever to the total mortality by towns from 1883 to 1893 inclusive, also the average for the state.

These diagrams represent graphically the actual variation in the mortality rate from this disease for the period given. The dotted line represents the average death rate from typhoid fever for the entire state, and the variations from this average are readily seen at a glance. A closer examination of this diagram in connection with Table No. 1 shows that in the instance of towns with a very small population, the mortality line as well as the percentage may be seriously affected by one or two deaths even, as for illustration, in Dorchester, Lincoln, Dummer, etc., and this should be taken into account in considering these figures in towns with a very small population. The rates, however, are actual, and are given more for the purpose of maintaining a record, which in connection with similar statistics gathered in years to come, may be of considerable advantage in determining questions relating to the development and prevalence of this disease.

In towns with a large population, and in the cities, the percentages are more suggestive of actual rather than accidental conditions, and should be taken into serious account by health officers when studying the sanitary needs and requirements of their respective localities. There are many suggestions as well as some important facts to be derived from these statistics.

The general prevalence of typhoid fever is not uniform throughout the state. For instance, there is an average greater mortality from this malady in Coös county than in the other counties of the state. Sanitarians, and others who have given the subject careful study, can readily account for variations of this nature.

TABLE No. 2.

Diagram showing the relative mortality from Typhoid Fever to total mortality, by towns, from 1883 to 1893, inclusive; also average for the state.

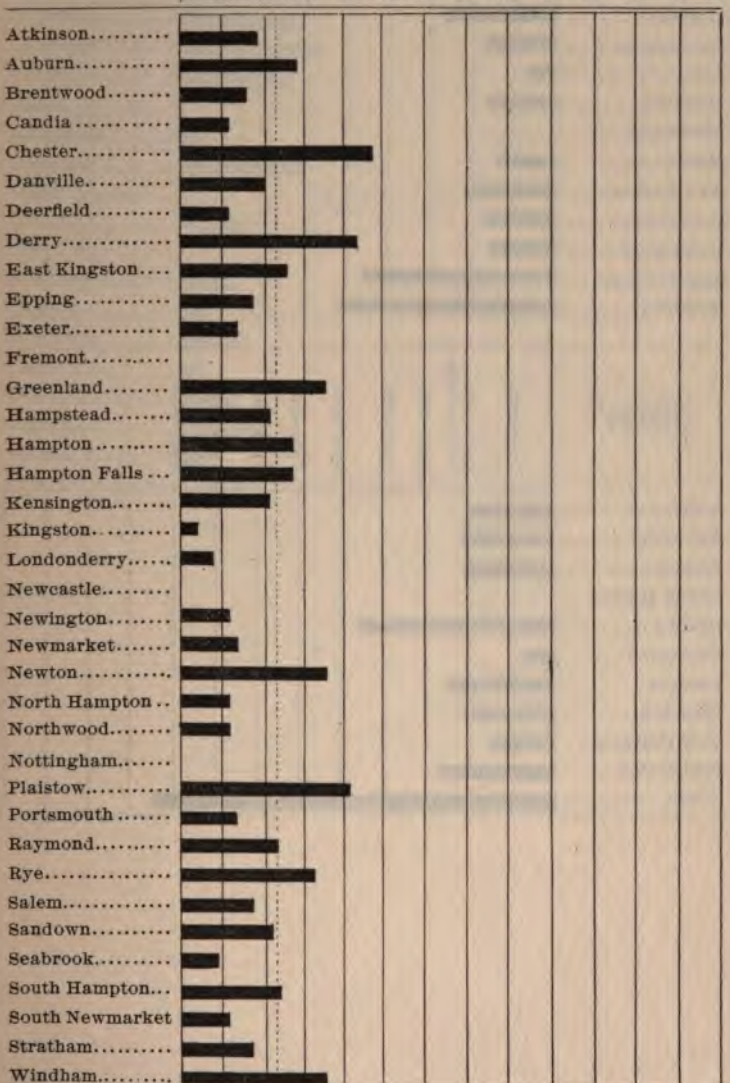
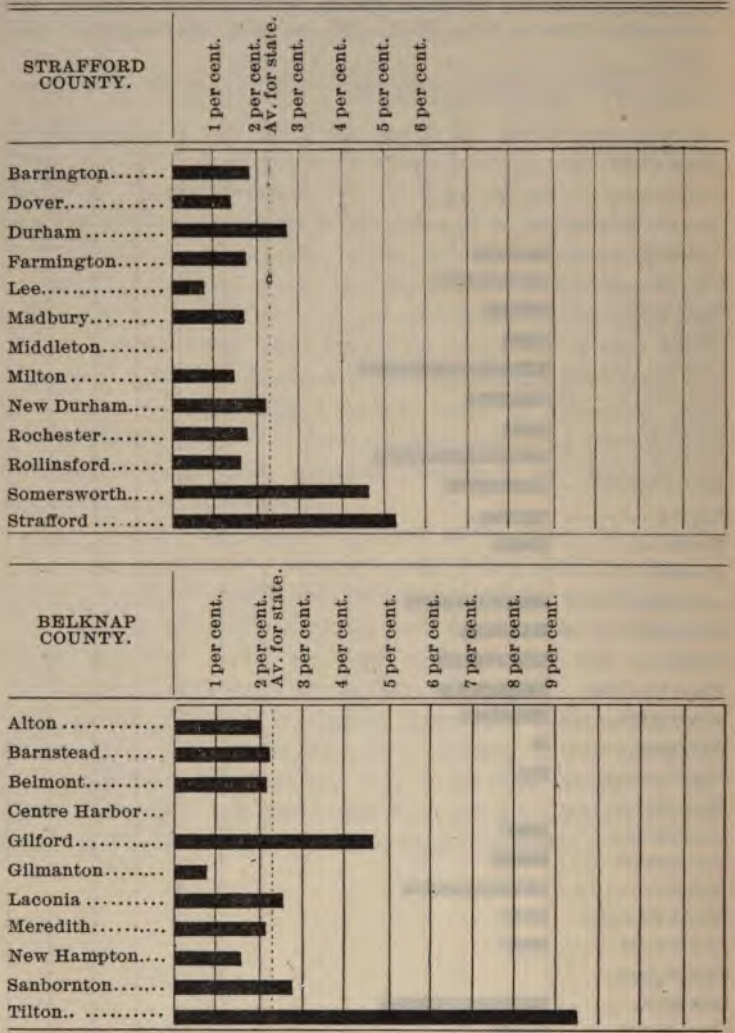


TABLE No. 2.—*Continued.*



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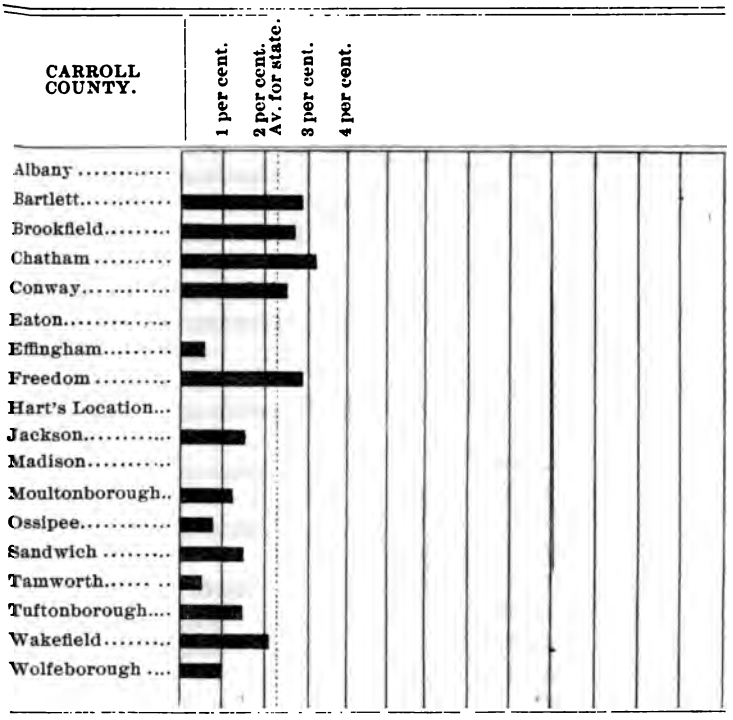

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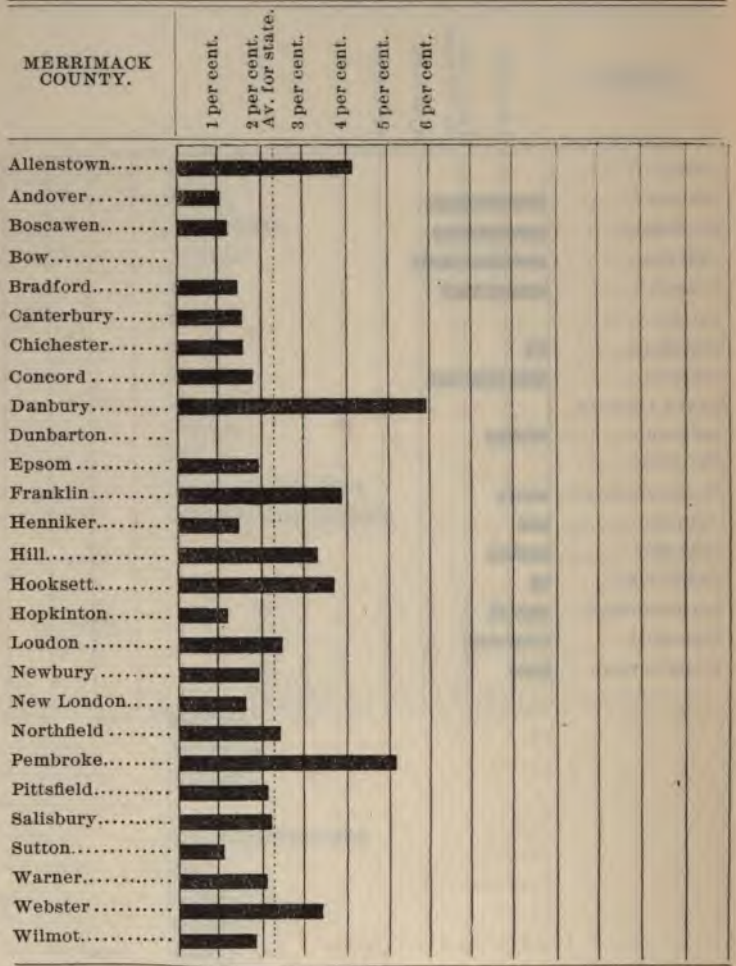

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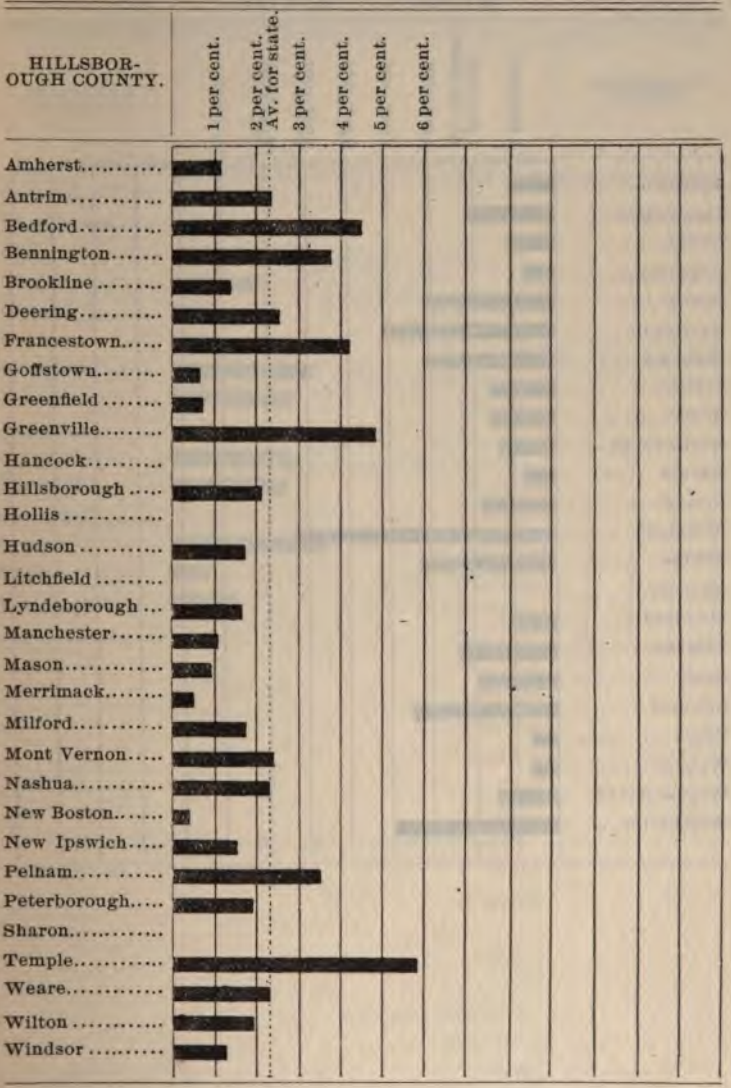

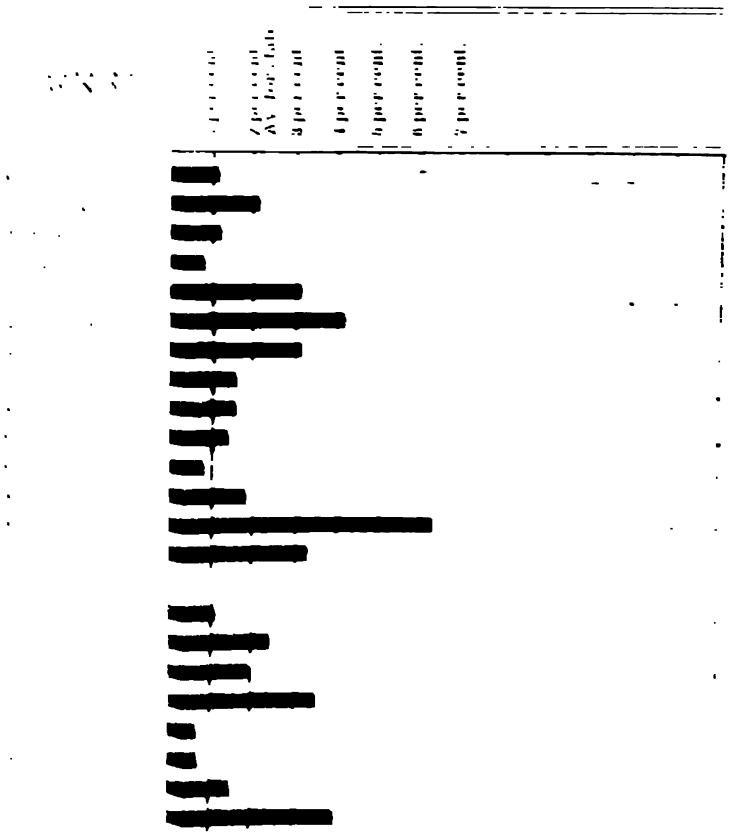

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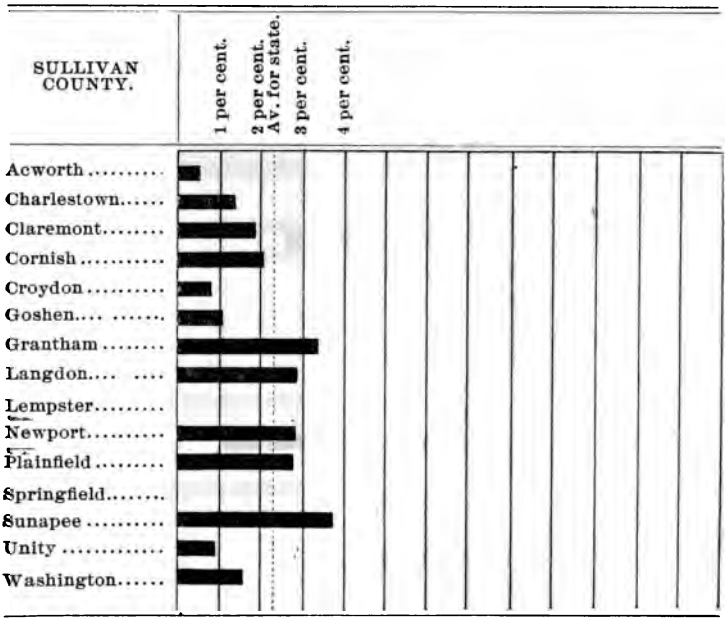

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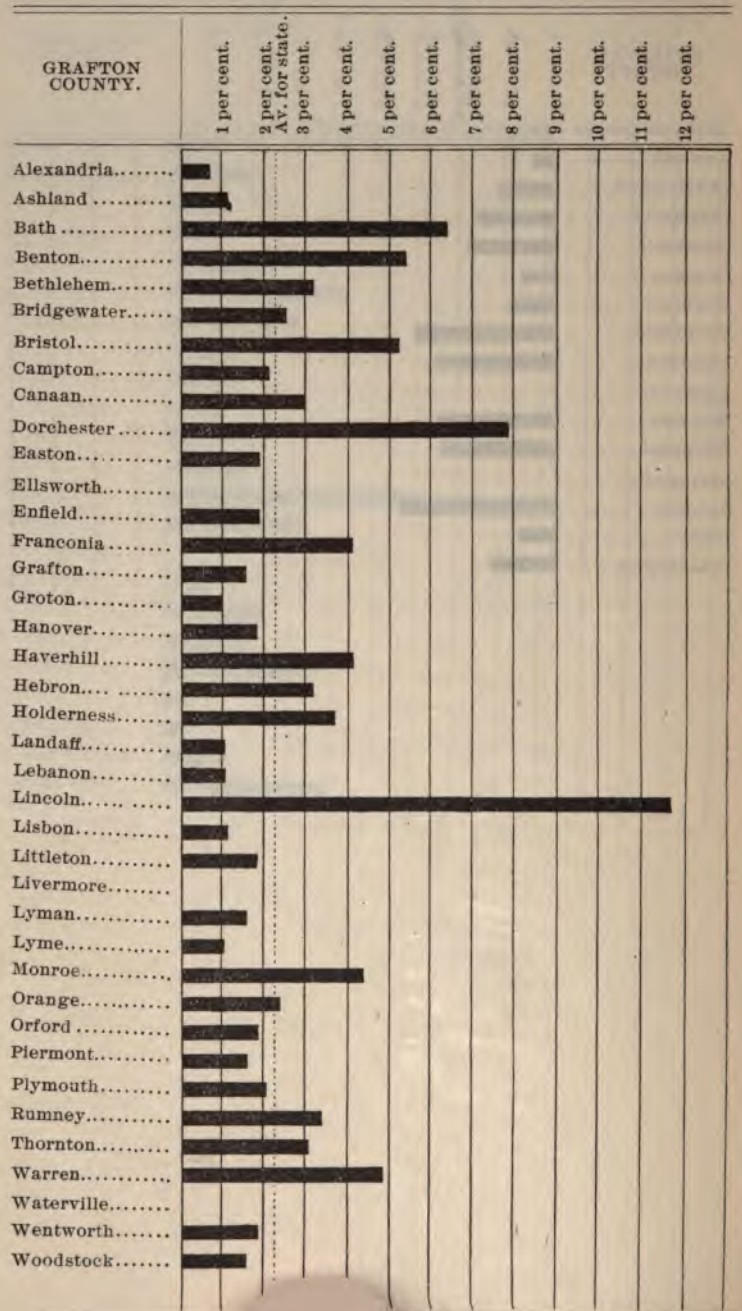


TABLE No. 2.—*Continued.*

Table No. 3 shows the mortality from typhoid fever, by months and sex, from 1883 to 1893 inclusive.

This table illustrates fully the fact that typhoid fever prevails at all times. Before records of the causes of mortality were kept, it was very generally believed that typhoid fever prevailed during the autumn months only, and that a case in midwinter was exceedingly rare, if, indeed, it ever occurred. The statistics show this view to be wholly erroneous. For the period included in the table, the number of deaths by months, commencing with the period of greatest mortality, was as follows: October, 292; September, 266; November, 212; August, 186; December, 133; January, 107; March, 101; May, 94; July, 93; February, 87; April, 83; and June, 75.

The greatest mortality was in October, and the smallest in June.

TABLE No. 3.

Showing Mortality from Typhoid Fever by Months and Sex from 1883 to 1893, inclusive.

YEARS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Not stated.	Total.
1883....Males	2	5	1	9	5	2	7	15	11	14	6	3	2	82
Females	5	6	5	4	3	2	8	10	15	14	11	5	2	90
1884....Males	5	3	4	3	4	2	4	9	8	9	9	6	1	67
Females	3	4	3	5	4	2	3	9	16	22	10	4	1	86
1885....Males	2	6	4	2	8	6	1	4	14	6	8	7	.....	68
Females	6	2	9	6	4	8	2	4	14	11	5	4	.....	75
1886....Males	4	4	9	9	3	7	9	13	20	22	10	8	.....	118
Females	6	7	5	2	5	6	3	14	8	23	13	7	.....	99
1887....Males	2	4	3	5	4	1	1	11	16	14	10	5	.....	76
Females	4	2	6	4	4	2	4	9	18	10	9	6	.....	78
1888....Males	8	4	4	3	4	7	6	8	15	12	14	12	.....	97
Females	2	4	5	6	2	6	.....	12	7	9	5	7	1	66
1889....Males	6	4	5	2	3	5	8	7	11	20	10	14	.....	95
Females	5	3	4	6	4	3	7	9	10	15	12	1	.....	79

1890....Males	12	4	3	4	6	1	3	7	17	12	5	3	.....	77
Females	9	8	8	3	4	1	6	4	10	6	9	5	.....	73
1891....Males	5	5	5	2	5	3	3	12	10	19	25	10	.....	104
Females	7	2	2	2	3	1	1	8	13	12	11	8	.....	70
1892....Males	7	2	4	1	2	1	2	4	5	12	7	7	.....	54
Females	2	2	1	1	7	3	5	3	11	7	9	6	.....	57
1893 ...Males	5	5	6	3	3	3	7	6	6	7	6	2	.....	59
Females	.....	1	5	1	7	3	3	8	11	16	8	3	.....	66
Total males	58	46	48	43	47	38	51	96	133	147	110	77	3	897
" females	49	41	53	40	47	37	42	90	133	145	102	56	4	839
Grand total	107	87	101	83	94	75	93	186	266	292	212	133	7	1736

TABLE No. 2.—*Continued.*

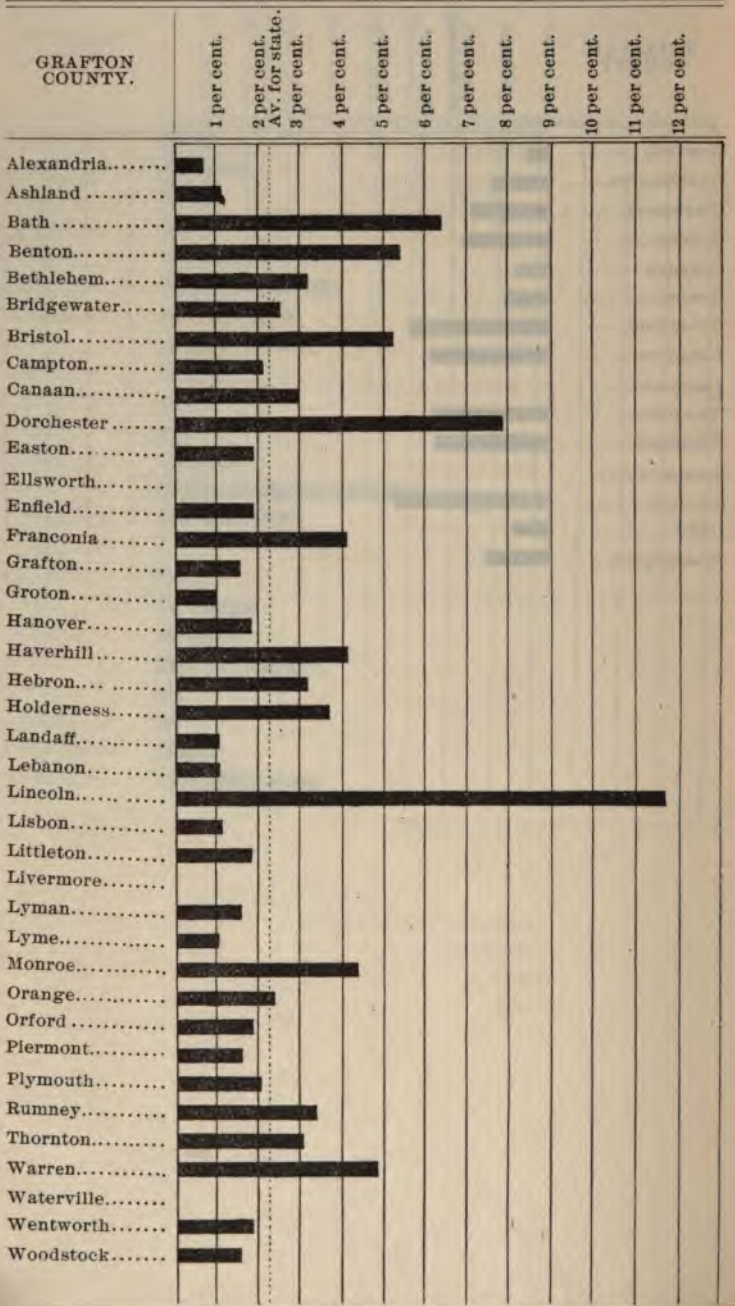


TABLE No. 3.

Showing Mortality from Typhoid Fever by Months and Sex from 1883 to 1893, inclusive.

YEARS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Not stated.	Total.
1883....Males	2	5	1	9	5	2	7	15	11	14	6	3	2	82
Females	5	6	5	4	3	2	8	10	15	14	11	5	2	90
1884....Males	5	3	4	3	4	2	4	9	8	9	9	6	1	67
Females	3	4	3	5	4	2	3	9	16	22	10	4	1	86
1885....Males	2	6	4	2	8	6	1	4	14	6	8	7	.....	68
Females	6	2	9	6	4	8	2	4	14	11	5	4	.....	75
1886....Males	4	4	9	9	3	7	9	13	20	22	10	8	.....	118
Females	6	7	5	2	5	6	3	14	8	23	13	7	.....	99
1887....Males	2	4	3	5	4	1	1	11	16	14	10	5	.....	76
Females	4	2	6	4	4	2	4	9	18	10	9	6	.....	78
1888....Males	8	4	4	3	4	7	6	8	15	12	14	12	.....	97
Females	2	4	5	6	2	6	.....	12	7	9	5	7	1	66
1889....Males	6	4	5	2	3	5	8	7	11	20	10	14	.....	95
Females	5	3	4	6	4	3	7	9	10	15	12	1	.....	79

1890....Males	12	4	3	4	6	1	3	7	17	12	5	3	.....	77
Females	9	8	8	3	4	1	6	4	10	6	9	5	.....	73
1891....Males	5	5	5	2	5	3	3	12	10	19	25	10	.....	104
Females	7	2	2	2	3	1	1	8	13	12	11	8	.....	70
1892....Males	7	2	4	1	2	1	2	4	5	12	7	7	.....	54
Females	2	2	1	1	7	3	5	3	11	7	9	6	.....	57
1893 ...Males	5	5	6	3	3	3	7	6	6	7	6	2	.....	59
Females	.....	1	5	1	7	3	3	8	11	16	8	3	.....	66
Total males	58	46	48	43	47	38	51	96	133	147	110	77	3	897
" females	49	41	53	40	47	37	42	90	133	145	102	56	4	839
Grand total	107	87	101	83	94	75	93	186	266	292	212	133	7	1736

TABLE No. 4.

Showing Mortality from Typhoid Fever from 1883 to 1893, inclusive, by Ages, Sex, etc.

YEARS.	Under 1.	1 to 5.	5 to 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Not stated.	Total.
1883....Males	2	10	1	1	7	27	6	7	7	6	6	3	1	82
Females	.....	9	2	8	16	17	9	5	9	5	6	3	1	90
1884....Males	3	6	2	5	6	18	6	4	6	4	5	2	.....	67
Females	2	5	5	8	15	17	7	8	3	6	3	4	3	86
1885....Males	2	4	1	3	11	18	8	4	4	5	6	1	1	68
Females	1	3	7	8	11	17	6	4	4	5	6	2	1	75
1886....Males	1	5	8	6	18	31	11	13	6	7	8	3	1	118
Females	5	3	7	6	15	20	7	5	10	8	12	1	.....	99
1887....Males	1	5	1	7	12	22	11	5	5	5	1	1	.....	76
Females	2	1	1	9	10	20	9	4	9	6	5	1	1	78
1888....Males	3	7	1	6	16	27	8	7	5	5	8	.....	4	97
Females	1	6	3	5	11	15	4	3	6	4	3	3	2	66
1889....Males	2	4	3	4	12	36	10	8	7	4	2	3	.....	95
Females	3	1	7	10	15	15	3	9	6	2	5	2	1	79

1890....Males	.....	.....	5	5	11	21	11	6	7	3	4	1	3	77
Females	1	3	5	7	13	12	8	5	7	4	5	2	1	73
1891....Males	.....	2	5	5	14	35	13	10	6	5	7	2	.....	104
Females	1	1	9	7	14	18	4	5	3	4	2	1	1	70
1892....Males	.....	4	1	2	10	14	12	1	3	4	1	.....	2	54
Females	1	2	3	8	7	11	6	7	2	3	2	4	1	57
1893....Males	1	3	1	3	10	14	12	5	4	4	1	.....	1	59
Females	.....	6	2	6	13	17	11	5	2	1	1	2	.....	66
Total Males	13	50	29	47	127	263	108	70	60	52	49	16	13	897
Females	17	40	51	82	140	179	74	60	61	48	50	25	12	839
Grand total	30	90	80	129	267	442	182	130	121	100	99	41	25	1,736
Percentage to the living of the same age groups	.48	.37	.26	.41	.78	.67	.36	.32	.36	.41	.68	.81	.....	.48

Table No. 4 shows the mortality from typhoid fever, from 1883 to 1893 inclusive, by ages, sex, and percentage of deaths by age periods to the same age groups of the living population.

The number of deaths was 1,736, distributed by age groups as follows: Under one, 30; one to five, 90; five to ten, 80; ten to fifteen, 129; fifteen to twenty, 267; twenty to thirty, 442; thirty to forty, 182; forty to fifty, 130; fifty to sixty, 121; sixty to seventy, 100; seventy to eighty, 99; over eighty, 41; and ages not stated, 25.

It will be seen by a glance at the table that the greatest number of deaths are recorded in the age group from twenty to thirty; but these figures, as well as the total number of deaths for the other periods, do not indicate the relative mortality of the disease for such age periods. In other words, it does not follow that because the greatest number of deaths are registered in the age group between twenty and thirty, that period of life is more liable to the disease. In order to ascertain all the facts pertaining to this question, it becomes necessary to study the ages of the population by similar groups. To that end, we have taken the census returns for the years 1880 and 1890, and averaging the figures for these two periods we have the following table, which shows approximately the number of people living in New Hampshire by age groups.

TABLE No. 5.

Population by age groups. Average and percentage, 1880–1890.

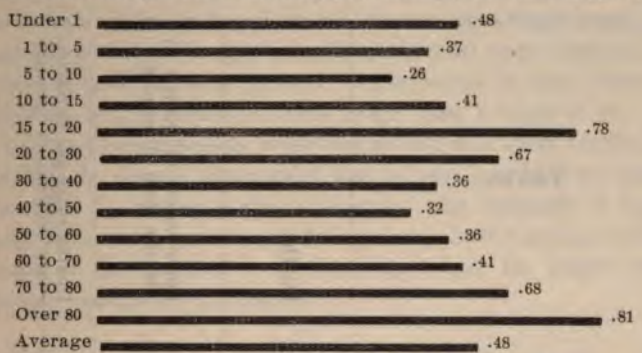
	Average 1880–1890.	Percentage to total population.
Under 1 year	6,244	1.72
1 to 5 years	24,203	6.69
5 to 10 years	30,471	8.42
10 to 15 years	31,494	8.71
15 to 20 years	34,050	9.41
20 to 30 years	65,962	18.23
30 to 40 years	50,038	13.83
40 to 50 years	41,145	11.37
50 to 60 years	33,515	9.26
60 to 70 years	24,432	6.75
70 to 80 years	14,600	4.04
Over 80	5,082	1.45

Total population, census 1880 346,991
" " " 1890 376,530

Table No. 5 shows the percentage of the population by age groups to the total population of the state. If, therefore, we take the total number of deaths by age periods and make a computation with the total number of living of the same ages, we shall as a result obtain the relative mortality from typhoid fever by age periods. This calculation shows the percentages at the bottom of Table No. 4, but is better illustrated in the diagram of Table No. 6.

TABLE No. 6.

Diagram showing percentage of Deaths from Typhoid Fever, from 1883 *to* 1893 *inclusive, to the total living population of the same age period.*



A glance at the diagram shows that the greatest relative mortality from typhoid fever is,—

1st. Among persons over eighty years of age.

2d. Between fifteen and twenty.

3d. Between seventy and eighty.

4th. Between twenty and thirty.

5th. Under one year of age.

6th. Between ten and fifteen, and sixty and seventy, the percentages being equal in each of those periods.

7th. Between one and five.

8th. Between thirty and forty and between fifty and sixty, the percentage of these groups being the same.

9th. Between forty and fifty.

10th and last. Between five and ten.

While these percentages show correctly the relative death rate for the ages given, it is quite probable that they do not show the

relative prevalence of the disease by age groups, inasmuch as it is doubtless relatively much more fatal among those groups representing the more advanced ages than in the groups representing the younger classes. In other words, the recuperative powers of the young and middle aged are much greater than those of the older age periods, hence the mortality would be much larger in the latter class, and therefore the diagram would not represent the relative prevalence of the disease, although it does show the relative death rate.

TABLE No. 7.

Mortality from Typhoid Fever from 1883 *to* 1893, *inclusive.*

YEARS.	Deaths.	Percentages of deaths to deaths from all causes.	Deaths-rates per 10,000 living (estimated population).
1883	172	3.19	3.83
1884	137	2.21	3.81
1885	136	2.19	3.75
1886	194	3.01	5.31
1887	134	2.06	3.64
1888	150	2.18	4.04
1889	161	2.40	4.30
1890	143	1.94	3.79
1891	170	2.42	4.48
1892	109	1.36	2.85
1893	121	1.58	3.14
Total	1,627	.....	.....
Average	148	2.23	3.90

Table No. 7 shows the mortality from typhoid fever, from 1883 to 1893 inclusive, together with the percentages of deaths to deaths from all causes, and also the death rate per 10,000 living (estimated population).

There were returned for the eleven years embraced in the table a total of 1,627 deaths from this disease—an average annual rate of 148. Since 1891 the number of deaths from typhoid fever has been somewhat below the average for the entire period. The foregoing tables and diagrams indicate as nearly as possible the situation in New Hampshire as respects typhoid fever. A review of these facts for ten years eliminates largely any erroneous calculations that might be based on the returns of a single year. The facts show that we have in this state an annual crop of typhoid, not excessive from the standpoint of its prevalence in other states and localities, but, nevertheless, much larger than it ought to be. It is a subject which interests every community and every family, inasmuch as the disease is one which may be very largely if not entirely controlled by proper sanitary measures. An outbreak of typhoid fever means that there is something wrong in the sanitary environments of the locality, or at the place where the patient unfortunately contracted the disease.

THE TYPHOID GERM.

It is now known beyond question that typhoid fever is caused by a microscopic germ, and that without this germ there would be no typhoid. In other words, a person cannot contract typhoid fever unless he takes into his system the germ of the disease, which can only come about through the sanitary neglect of somebody.

While there is a difference of opinion as to the morphological history of this germ, there is no controversy over the fact of its existence and its results. Some observers hold to the view that the germ or bacillus known as the Eberth-Gaffky bacillus is the sole cause of typhoid fever, as it is known to be in this disease constantly present in the alimentary canal, in the mesenteric glands, spleen, etc. Indeed, this view is probably held by a great majority of bacteriologists who have given this disease more or less study. On the other hand, equally able observers, like Rodet, G. Roux, Ballet, Arloing, Kellogg, and others, entertain the opinion that the germ known as the *bacillus coli communis*, which is normally

present at all times in the alimentary canal of man, acquires in sewage specific and virulent properties, so that when re-introduced into the human organism it creates typhoid fever.

This theory would certainly explain in a most logical way the appearance of cases of typhoid fever which are said to arise *de novo*. It would illustrate in a most forcible manner the danger that comes from the pollution of water supplies, more especially wells located in close proximity to certain unsanitary conditions.

There are other observers who believe, from laboratory experiments, that typhoid fever may be produced by three or four varieties of germs, which are often if not always found in sewage in certain stages of decomposition.

It will therefore be seen that while there is a difference of opinion as to the character and kind of germs which may produce typhoid fever, there is no controversy over the fact that typhoid fever is a germ disease. To this all agree. Therefore, from the standpoint of the individual, the sanitarian, and the health officer, these points are not essential.

Communities are not especially interested or concerned over the natural history of the germ or germs which cause typhoid fever, their special interest being in the prevention of the disease; but at least a superficial knowledge of the causes of typhoid is necessary to a correct understanding of the methods required to prevent the spread of this disease.

TYPHOID FEVER A PREVENTABLE DISEASE.

The history of typhoid fever, taken in connection with the wonderful control over the disease which has been accomplished by the work done in many towns and cities of this country and in Europe, shows this malady to be one of the diseases most easily prevented and controlled. As an illustration of this point we quote from a recent paper by Prof. Victor C. Vaughan:

I have said that typhoid fever is a preventable disease, and that the large number of deaths from the disease is unnecessary. This is true not only theoretically, but practical demonstrations are not wanting. Prior to 1859 the city of Munich in Bavaria was a veritable hot-bed of typhoid fever. There were no sewers and no public water supply. Most of the houses were furnished

with large brick or wooden flues which were built from the cellar up through the different floors. Into these the excretions from the body were dropped, and accumulated in the cellars. Other waste material was deposited in cesspools, and garbage was thrown into the back yards. The air in the houses was foul and offensive to the smell. The drinking water was taken from shallow wells in the yards, and these often received the ooze from the cesspools and vaults. In 1859 the citizens were compelled to cement tightly the bottoms and sides of these receptacles of filth, and later a system of sewerage was introduced, and later still a supply of wholesome water was obtained. Notwithstanding the fact that portions of the city still remained unsewered at the time of the last report, the results have been most gratifying as is shown by the following table given by Bollinger :

Typhoid deaths in the civil population of Munich per nine thousand inhabitants :

1852–'59	24.2
1860–'67	15.6
1868–'75	12.7
1876	6.8
1877–'79	7.8
1880	6.4
1881	1.4
1882	1.9
1883	1.9
1884	1.4

This shows what has been done in an old and crowded city, and Vienna has practically repeated the demonstrations made by Munich.

The number of deaths from typhoid fever in the United States is about eight per ten thousand. The reduction of this mortality to the same extent that has been actually accomplished in Munich would save in round numbers not less than forty thousand lives each year.

For several years this board took especial pains to investigate as far as possible the causes of typhoid fever in this state, and the result showed that contaminated water was by far the greatest source of infection. In many cases typhoid fever was reported in isolated localities with no history which showed the connection of the case with a prior case, and where the water supply was badly

polluted by the drainage of the premises. Indeed, so many cases of this kind have been noted that it is difficult for the observer to believe that every case of this kind had for its origin a prior case. On the other hand, there is plenty of evidence tending to show that certain unsanitary conditions are responsible for the outbreak of the disease. All authorities agree that drinking infected water of wells has long been known to be a prolific cause of typhoid fever. The evidence is unquestionable that this disease is more extensively produced through contaminated drinking water than from any other cause.

There are numerous instances on record of wholesale infection of communities through the contamination of the general water supply. Many of these instances are now historical. One of the most recent of the kind is the epidemic which occurred early in the present year at Windsor, Vt. In discussing this outbreak, Dr. J. D. Brewster of that place says:

The first case was reported March 15th, and was in a family who resided at the extreme southern limit of the village, and at the time there could not be found any apparent cause for the disease.

No further case appeared until March 24th and 25th, at which time a large number of people were taken with high fever, which soon showed itself to be unmistakably typhoid fever. These cases were among all classes of people, the rich and poor alike, but all within the village limits.

Observation soon showed the disease was confined entirely to families using the village water supply, those having wells being entirely exempt, except in cases of children who drank the water at school. This fact led immediately to the examination of the water system. Windsor was supplied by a series of springs situated about two miles or more from the centre of the village; these springs formed a small brook, which ran along a valley for about a mile, passing six farms and dwelling houses and then emptying into a reservoir, from which iron pipes conveyed the water into the houses. Now, about forty rods above the rise of the brook, a farm house is situated where it was ascertained a person had suffered the previous January from a feverish condition for about four weeks; it was supposed to be a non-infectious form of fever, and was not reported to the local board of health, and consequently no care was taken of the discharges of the patient and

they were thrown into the vault; to make matters worse, the sink drain was frozen at the time, so all wash-water was thrown out upon the snow. During the very warm weather which we had the first week in March the snow melted, and all this accumulation easily found its way into the brook and thence into the reservoir and our homes. This explanation was unanimously endorsed by the state board, who made an official visit to the place soon after the outbreak. The local board at once issued orders to have all water for cooking or drinking puposes boiled. At the same time the town provided a water cart to deliver water at the houses from an adjoining spring.

From March 24 to 30 about eighty cases were reported; from this date to April 27 the cases became less frequent, this time being probably the limit of the primary cases, the later ones being secondary, and mostly occurred in families already suffering from the disease. Up to July 28 there were 130 cases, these occurring in 68 families; the largest number afflicted in one family being five, the majority only one. The ages ranged from 10 months to 92 years, but the majority were under 20 years of age, and a large per cent. were children. These withstood the disease to a remarkable degree, even with a protracted evening temperature of 104. The population of Windsor is 1,300, so about 10 per cent. of the inhabitants were affected. We were fortunate in having only 17 deaths, or 13 per cent.

Dr. F. A. Hodgdon of Peterborough, in a recent communication to this board, says:

Drinking water so often polluted becomes one of the most common sources of typhoid fever. The following cut illustrates the location of a tenement house and its relation to a polluted well, in which house occurred six cases of typhoid fever in one family following one another in rapid succession, so that there were five in bed at one time. In an epidemic of 22 cases in Peterborough in September and October of 1894, these six cases were among the first to appear, and upon the same street six others came down soon after, showing to me that the poison from this well played no small part in the causative action of these cases.

I may say that this well was situated 18 feet from a privy, which had not been cleaned out for at least a year, so far as any one could vouch for certain. For 40 years the sink spout had come outside the house and been pouring its poison within ten

feet of the well. With the privy vault upon one side and the sink upon the other, this well had been fed for the last half century with such pollutions as would develop microbes in such myriad numbers that they might storm a city. It teaches me if more attention could be paid to the privy vaults and cess-pools, and drainage generally, that a large number of these cases of typhoid fever could be avoided.

All these cases recovered, as did also the 22 above referred to. All were mild, yet typical. I called Dr. C. J. Allen in to see these cases with me, and he compared the diagnoses and concurred in the causes of them after carefully looking about the premises.

There are, however, many other sources of danger. Vaughan says:

I am rather insistent upon the possibility of the spread of the typhoid germ through the air, because I am convinced that the possibility of such means of dissemination is sometimes overlooked. There is another reason for the special mention of this point, and this is the custom prevalent in many places of drying the fæcal matter within the building by means of warm foul air as it is drawn into the exit flue. This method of disposing of the excretions of the human body has been adopted in many schoolhouses, and I believe that it is by no means devoid of danger. It is said by those who favor this method that the air of the rooms cannot become contaminated because it is constantly being drawn outward and there are never inward currents. In reply to this, I would say that there is no system of ventilation so perfect that counter currents are never formed by the opening of windows and doors. Fæcal matter should never be stored in inhabited buildings. It should be removed as speedily as possible. Currents of air will not take up germs from moist surfaces, but so soon as these masses of waste matter become dry there is danger of breathing the air which comes over or through them.

Prof. W. T. Sedgwick of Boston, in an interesting address delivered at the 21st annual meeting of the American Public Health Association, speaks as follows in regard to the methods of infection which came under his observation in connection with an outbreak of typhoid fever in Massachusetts:

There is still a third class of epidemics investigated by the State Board of Health of Massachusetts to which I wish to invite special attention,—namely, those epidemics due to what I may call secondary infection. One of these is shown upon a diagram which I show you. You will see the location of the milk epidemic to which I have referred, which infected the best part of the city of Springfield. Please bear in mind that the typhoid fever was not in the filthy part of the city, but in the magnificent portion of the town, where the houses have fine lots, where every prospect pleases, and where only milk is infected. It is now of secondary infection epidemics of which I wish to speak.

I have here an example in the town of Palmer. There is a district called Duckville, which is a portion of the village of Bondsville. There appeared here, after the Springfield milk epidemic, an interesting outbreak of typoid fever cases in the neighborhood of a well, which was located only thirty feet from the worst privies I ever saw. I saw houses grouped around the well, and the well was apparently in a terrible condition. On taking samples from it and examining them chemically and bacteriologically, we found absolutely no typhoid-fever bacilli, and hardly any germs of any kind. The water was seemingly remarkably well purified. From a chemical point of view, also, it was unobjectionable, because the well was a driven one, and the privies near by did not contaminate it. We found on tabulating the cases and making data that there was a curious sequence in the cases. They did not come down as the cases in Springfield, with one blow, as if some poison was widely distributed to many houses at once; nor did they come down as at Lowell. They came down one on the first, two on the second, one on the ninth, one on the twelfth, two on the fourteenth, and so on for a month. We found, in fact, a succession of cases. Beginning at number one, I traced the thing along until it spread to other portions of the village. In trying to find out the cause of this, I went into one of the houses of low grade in which the inmates were filthy in their habits. On one occasion I had a revelation: I found four people sick with typhoid fever in one room, and two in bed in an adjoining room. Those in the room were gathered around a table on which there was some food. Some in the prodromal stages were still sitting up. They were children, and would get off from the chair on which they were sitting, go out to the privy, and then come back, and without washing their fingers would

stagger up to the table and finger a big piece of cake which lay on it. They would then nibble a little bit, leave the rest, and sluggishly walk back to their seats. Another child would get off its chair, or a child would come in from the outside, would go up to the same table, break off a piece of cake and eat it. There was no question about how the infection was spreading in a case like that. From case A something was left upon the cake, and from the cake it soon found an entrance into the alimentary canal of the next child. The children went from house to house, —they live pretty much together,—the food stands on the table from day to day, and they lived that kind of a life in which the children eat food in common, and the food which went into the mouths of A, B, and C was fingered by D, E, and F, and it only required that D or E should have a case of typhoid fever to infect the others, one after another. We found, moreover, that the first case was unquestionably imported from a neighboring town, having been distributed in the way I have described. A large boarding-house, the occupants of which were using the well water all along, did not contain a single case of the disease; so I was forced to the conclusion that the well had nothing to do with it.

Typhoid fever is sometimes spread through infected milk. Such a result could not occur except through sanitary carelessness at the dairy. During the present year such an instance was reported by the secretary of the board of health of Titusville, Pa., as follows:

August 26, the first case of typhoid fever appeared in the city, and two days later two more cases. At this time I learned that a case of typhoid fever existed on a dairy farm about a mile north of the city, and that these parties were taking milk from this dairy. I immediately stopped them from bringing any more milk into the city. Within the next two weeks we had thirty-eight cases in town, and every one of them had been using milk freely from this farm previously to the time I stopped it from being brought into the town. The following week we had six more cases reported, two of which were imported cases, being men who had been working away from home and had come home sick with it. The other four had been users of this milk. Since then we have had six more cases reported, making fifty cases up to date. Of these six cases two were imported, and the other four have occurred in families where the disease had already

been existing from the use of this milk, and where the sanitary conditions were not what they ought to be, and the families had been very careless. Of this number, four have died. The first case on the dairy farm came there from Buffalo, N. Y. Shortly after she arrived home, her sister came down with the disease, and a little later her brother. The mother was taking care of her daughter and the milk at the same time. She was very uncleanly in her personal habits, and no precautions were taken at that time with the stools.

The sanitary conditions of the premises at that time were good. Three cases existed on this farm, independent of those in the city. Two parties visiting here at that time who used some of that milk went home and came down with the disease, and a number of others in the town who had used the milk showed symptoms of it for a few days.

COUNTY INSTITUTIONS.

THE STATE OF NEW HAMPSHIRE.

STATE BOARD OF HEALTH.

ROCKINGHAM COUNTY.

CONCORD, June 3, 1894.

Board of County Commissioners:

GENTLEMEN:—Certain facts having been presented to the State Board of Health relative to the prevalence of diarrhœal and typhoidal conditions among the inmates of the Rockingham county almshouse, and the conclusion having been arrived at that the said conditions are dependent upon a contaminated water-supply, it becomes our duty to render a report to your board, with recommendations.

Recognizing yourselves that something should be done to remove the cause of so much illness, your board invited the secretary of the State Board of Health to inspect the premises, which he did on June 7. There were present at the time of the inspection the full board of county commissioners, the superintendent of the almshouse, Drs. Henry L. Sweeny and Abram W. Mitchell, ex-physician and physician, respectively, to the institution, an engineer, and others. A thorough examination of the premises was made and a general consultation held.

By request the physicians named have made brief statements, copies of which are herewith given:

To I. A. Watson, M. D., Secretary State Board of Health:

Agreeably to your request I submit the following report in regard to the sanitary condition at the Rockingham County Farm on May 10, 1893:

Entered upon my duties as physician to the inmates of the Rockingham county almshouse, asylum, and house of correction. In July of that year there was a severe outbreak of diarrhœa, which spread rapidly among the inmates, proving rather intractable in some cases, but resulting fatally in only two, both old and much debilitated persons. At once the physicians began their search for the cause of the outbreak. The plumbing, closets, and drains about the buildings seemed to be in a satisfactory condition, and chloride of lime was being freely used in the closets and drains, and the whole system thoroughly flushed twice daily. At the outlet of the sewer a defect was found, but was at once remedied when the attention of the superintendent was called to it. By the order of the physician the well was pumped out as thoroughly as possible, soups were dropped from the list, and the diet of the inmates generally revised and restricted. They were also warned and forbidden from using the water from the pond for drinking.

Despite our efforts the diarrhœa continued throughout the summer months, and only entirely disappeared with the advent of cold weather. In the fall we had several cases which developed typhoidal symptoms, and two at least of typhoid fever of a mild type. This year we are beginning to experience the same trouble a month earlier than last, several cases of diarrhœa having appeared within the last week.

The water supply of the place has been examined, samples analyzed, and the results, as well known to you, show pollution to such an extent as to necessitate absolutely a new source of supply, as the water from the purest source can only be used with great risk and danger. The only available source, it seems to me, which gives promise of a permanent supply free from danger, is by sinking an artesian well deep enough to exclude entirely the surface water, and this measure I am in favor of, have recommended, and do recommend to the commissioners of Rockingham county.

(Signed) HENRY L. SWEENY, M. D.

Kingston, June 7, 1894.

EPPING, N. H., June, 1894.

To Dr. Irving A. Watson, Secretary State Board of Health, Concord, N. H.:

DEAR SIR:—In the interest and behalf of the numerous unfortunate people confined or supported at the county institution at Brentwood, I would respectfully call your attention to the quality of the drinking water supplied to them. The analysis of all four possible sources—the pond, the new filter tank, the well, and the spring half a mile distant, are before you, and I feel sure that you will condemn these sources, as have we long ago, who have had to care for the very large number of patients made ill by the use of these waters. During the first three of the six years that I have been professionally connected with the farm, I can distinctly remember and state that no case of typhoid fever or diarrhœa resembling it originated on the place. In the fourth year the cases of diarrhœa had, in a few cases, a tendency toward typhoid that was suggestive. During the fifth year the tendency was more decided and manifest, while in the sixth or last season the epidemic of bowel troubles was terrible. Superintendent Dimond very willingly and kindly changed the regular diet, excluding soups, etc., and doing everything the physicians suggested. The commissioners furnished all the drugs asked for, and we used them to the best of our ability; but notwithstanding all this, the diarrhœa continued, grew worse, and several cases of unmistakable typhoid fever presented.

In view of the unfavorable analysis, our former experience, and the fact that several cases of diarrhœa have already made their appearance, dreading for the helpless and dependent inmates, for ourselves, and for the conscience and good reputation of the county the dangers impending, I earnestly entreat you to give this matter early attention and to aid us in furnishing a pure water supply.

(Signed) ABRAM W. MITCHELL.

It appears that for several years past the chief source of water supply has been from a brook which runs through the farm and within a few rods of the buildings. In order to create a reservoir of sufficient capacity, a dam was constructed which causes the water to flow quite an area of marshy or muddy land. Some distance above the dam upon this brook are some two or three brick-yards

which pollute it more or less and at one point a privy spans the brook, we are creditably informed. From this brook water is pumped into a tank of 10,000 gallons capacity, and thence distributed by pipes throughout the institution.

Suspecting the water from the brook to be unfit for domestic use, Superintendent M. J. Dimond sent a sample of it to Prof. E. R. Angell for analysis, and received the following report:

SANITARY ANALYSIS OF WATER, ROCKINGHAM COUNTY FARM.

Pond water.

Odor	Little
Color	Marked yellowish tint
Evaporation	Foamy
Residue	Yellowish circles and patches
Ignition of residue	It blackens strongly
Solids, grains per gallon	4.8
Loss on ignition, grains per gallon	2.2
Hardness, degrees	1.5
Alkalinity, degrees	2.0
Chlorine, grain per gallon	0.3
Free ammonia, part per million	0.252
Albuminoid ammonia	0.248
Nitric acid	None
Nitrous acid	None
Lead	None
Iron	Strong trace
Sediment	Too much

Microscopic examination; decomposing vegetable matter, infusoria, bacteria, diatoms.

Oxygen for oxidation, grain per gallon	0.497

This water is not suitable for drinking purposes. It contains too much vegetable matter in solution. (Signed)

EDMUND R. ANGELL.

Derry, N. H., May 23, 1894.

Recognizing the necessity for a better water supply, the commissioners caused a cistern to be constructed within a few feet of the pond, expecting that the water would filter through the intervening soil and fill the cistern with good water. Instead of this result the soil water from the higher ground, including the site of the almshouse and other buildings, leached into the cistern, filling it a foot or more higher than the level of the pond. Thus the attempt to obtain pure water by means of filtration from the pond into a cistern resulted in procuring a supply of ground water of doubtful quality. An analysis of this water was made May 23, with the following results:

SANITARY ANALYSIS OF WATER, ROCKINGHAM COUNTY FARM.

Cistern water.

Odor	Very little
Color	Slight tint
Evaporation	Quiet
Residue	Uniform and white
Ignition of residue	*It smokes and blackens some*
Solids, grains per gallon	*9.0*
Loss on ignition, grains per gallon	1.7
Hardness, degrees	3.0
Alkalinity, degrees	4.0
Chlorine, grains per gallon	*0.8*
Free ammonia, part per million	*0.089*
Albuminoid ammonia, part per million	*0.09*
Nitric acid	*Some*
Nitrous acid	*Little*
Lead	None
Iron	Trace
Sediment	*Too much*

Microscopic examination: *Sand, crystals of carbonate of lime, particles of straw, bacteria.*

Oxygen for oxidation, grain per gallon.....0.097

This water is questionable. I would not drink it myself. I italicize the objectionable results in the analysis. It is to be understood that the substances so marked are in excess, or are objectionable from their presence.

(Signed)

EDMUND R. ANGELL.

Derry, N. H., May 23, 1894.

Recourse has been had, more or less, to a well upon the premises for drinking water, situated some seventy-five or a hundred feet from the site of some old surface privies, which for some years polluted the soil to an excessive degree. Fearing that the water might also be contaminated, Mr. Dimond caused an analysis to be made of a sample taken from the well in May, as follows:

SANITARY ANALYSIS OF WATER, ROCKINGHAM COUNTY FARM.

Well water, sample No. 1.

Odor	Slight
Color	Slightly turbid
Evaporation	Nearly quiet
Residue	Quite uniform and white
Ignition of residue	It darkens a little
Solids, grains per gallon	9.6
Loss on ignition	4.3

Hardness, degrees	2.0
Alkalinity, degrees	1.8
Chlorine, grain per gallon	1.2
Free ammonia, part per million	0.087
Albuminoid ammonia, part per million	0.124
Nitric acid	Considerable
Nitrous acid	Little
Lead	None
Iron	Trace
Sediment	Some

Microscopic examination: Bacteria, infusoria.

Oxygen for oxidation.....None

The unfavorable features are: Too much loss on ignition; too much ammonia, both free and albuminoid; excess of chlorine. The natural amount of chlorine should not exceed ½ grain per gallon; excess of nitric acid, and presence of nitrous acid. These results show that this water contains drainage of some kind. It is very suspicious water.

(Signed)

EDMUND R. ANGELL.

Derry, N. H., May 28, 1894.

There is upon the farm, in the lowest part of a large field 2,300 feet distant, a spring from which it has been proposed to take the water for domestic use. A topographical examination of the spring indicates that a large proportion of its water is surface drainage only, as the natural drainage of the land is toward this spring, while one or two lines of subsoil drainage tile have been laid in a manner tending to take the drainage toward the spring. An analysis of the water in this spring recently made by Prof. Angell is herewith given.

SANITARY ANALYSIS OF WATER, ROCKINGHAM COUNTY FARM.

Sample No. 2.

Odor	Slight
Color	Yellowish and turbid
Evaporation	Foamy
Residue	In circles and yellowish
Ignition of residue	It blackens strongly
Solids, grains per gallon	9.3
Loss on ignition, grains per gallon	6.2
Hardness, degrees	3.0
Alkalinity, degrees	2.5
Chlorine, grain per gallon	0.8
Free ammonia, part per million	0.09
Albuminoid ammonia, part per million	0.32

Nitric acid.....None
Nitrous acid.....Some
Lead.....None
Iron.....Trace
Sediment.....Some
Microscopic examination: Bacteria, vegetable cells and tissue.
Oxygen for oxidation, grain per gallon.....0.97
This water is not suitable for drinking purposes.

(Signed) EDMUND R. ANGELL.

Derry, N. H., May 23, 1894.

Briefly the situation regarding the water supply of your county almshouse, asylum, etc., seems to be as follows:

1st. The pond made by a dam in the brook from which the greater part of the supply for the institution has been taken for the past few years, is of too poor a quality and of too suspicious a character to be used with safety. This supply receives the drainage of several brick yards and is liable with every shower to serious contamination.

2d. The cistern water is from the soil drainage of quite an area, probably embracing the entire site of the almshouse, asylum, and adjacent grounds, and therefore its use should be discontinued.

3d. The well, as has already been shown, is contaminated to an extent that renders the water unfit for domestic use. This contamination is doubtless due to long continued soil pollution in years past, and it is not probable that the soil will be freed from dangerous organic impurities for many years to come. Therefore the well should be permanently closed.

The question which presents itself to your board is, How shall an adequate water supply be obtained for this institution? It has been conclusively shown that neither of the sources from which water has been or is now being taken should be continued, and it therefore becomes the duty of your board to furnish a new supply at the earliest possible moment.

The diarrhœal and typhoidal conditions which have prevailed at the institution, baffling the skill of your physicians, together with the analyses above given, would seem to establish beyond reasonable doubt that the cause is to be found in the water used at the almshouse. I think these points have been so definitely settled that they need no further discussion. The problem of obtaining a new supply is the vital question with which you have to deal.

The only available water in sight, within a reasonable distance, is the spring above mentioned, and the water from this source has been shown by analysis to be unfit for domestic purposes, in addition to the fact that it does not, in all probability, contain a sufficient supply for the institution.

There appears, therefore, to be but one readily available source for a water supply of a satisfactory quality and sufficient quantity, to wit: an artesian well. Judging from the geological formation of the locality, with strata of clay and rock formation and intervening beds of quicksand, we should expect to obtain, within a reasonable depth, by means of an artesian well, a water supply that would be adequate in all respects for the institution.

We therefore recommend that you take immediate measures to carry out the suggestions embodied in this report.

Respectfully submitted,

IRVING A. WATSON,
Secretary.

Soon after the receipt of the foregoing communication, the county commissioners contracted for an artesian well in accordance with the recommendation submitted to them. A well was put down to the depth of 241 feet, and lined with a six-inch pipe. A great abundance of water was found. The pump, operated by steam, was put down sixty feet below the surface, and the whole enclosed with a small brick building. The capacity of the well is fifty gallons per minute, and the quality of the water all that could be desired, so that at the present time the Rockingham County Almshouse is supplied with an abundance of good water, the desideratum long desired.

The total cost of the well, including pump and house, was about $2,500.

ROCKINGHAM COUNTY ALMSHOUSE AND ASYLUM.

This institution remains in practically the same condition as heretofore (see former reports of this board). Some minor improvements, however, have been made. The buildings are in a cleanly condition, and show excellent administrative ability upon the part of the superintendent and matron.

It is to be regretted that we cannot speak with commendation of the almshouse proper. We have stated it to be unfit for the

purpose to which it is put in our former reports, and in this respect the conditions remain the same. It is a cheaply made wooden building, and at all times is a veritable fire-trap, notwithstanding within the last two or three years additional water facilities have been supplied to the institution. They are, however, inadequate to cope with a fire once well started. We do not feel like recommending to the county anything short of a new building in the place of the main almshouse, to be constructed of brick, and upon modern plans and principles.

The institution appears to be well managed in every particular.

There were present at the time of the inspection 230 inmates.

STRAFFORD COUNTY ALMSHOUSE.

During the year a number of improvements have been made in this institution. The old system of sewerage has been entirely abandoned; the house has been thoroughly re-plumbed and a sewer constructed from the buildings to the river. This change has greatly improved the sanitary condition of the institution. The work seems to be well done. The fixtures are all arranged, and seem to be ample for the needs of the institution. The closets, which formerly were adjacent to the dining room, have been removed to another part of the building, and thoroughly refitted. Two new bath tubs have been put in; several new sinks have also been introduced and are well supplied with hot and cold water. The entire system of steam heating has been overhauled and reconstructed so it is now satisfactory, and furnishes an ample amount of heat to all the rooms. A new boiler house has been erected some fifty feet from the two wings of the almshouse, and a steam main is carried to each wing; new radiators have been put in throughout, and the test of one winter shows that the institution can be thoroughly heated with the present system, with from one to four pounds of steam. The reconstruction of the heating system has made a saving of nearly $600 a year in fuel. Steam cooking has been introduced into the kitchen, and is giving great satisfaction.

The institution presents a cleanly appearance throughout. The walls and ceilings have been whitewashed or painted, so that the rooms present a clean and tidy appearance.

The water supply seems to be ample. There is a storage of

120,000 gallons in the tanks, and four streams can be played upon the buildings at once, and the highest portions of all the buildings can be readily reached by the use of the steam pump, which is ready for use night and day. The steam for cooking is taken from the power boiler, hence the latter is always under pressure and ready for immediate use. The steam plant is supplied with three boilers, so in case of accident to one the others can be brought into immediate requisition.

The cost of the improvements which have been made in this institution within the past year aggregates some $15,000.

There are one hundred inmates.

The insane asylum, which was burned a few years ago, has not been rebuilt. The county maintains some fifteen or twenty insane patients at the New Hampshire Asylum for the Insane.

BELKNAP COUNTY ALMSHOUSE.

This institution is located in the town of Laconia, between one and two miles from the station. It is on a healthful site, at a good elevation a short distance from the bay between Laconia and Lakeport.

The buildings consist of the almshouse proper, the county jail, and an adjacent building for the insane, with stables and outhouses.

Within a few years many improvements have been made at this institution, such, for instance, as remodeling the heating apparatus, the introduction of the city water supply, better protection against fire, and a better general condition of the buildings themselves.

The entire institution contained at the time of the last inspection sixty inmates, seven of whom were prisoners in the jail, and seven insane persons confined to the out-building used for this class of patients.

The main almshouse is in an excellent condition. The woodwork is painted annually, and the ceilings frequently whitewashed, so that the general appearance of the rooms is excellent. The heating and water supply are ample. The windmill which was formerly the only means of obtaining water for the institution, is still used in order to economize in the cost of the use of water from the city supply, the latter being used only when necessary.

The buildings seem to be fairly well protected from fire, so far as means of extinguishing the conflagrations are concerned. There is a stand-pipe to which 150 feet of hose is attached, upon each floor of the almshouse. There is a street hydrant about 100 feet distant from the main house, and a supply of 500 feet of fire-hose. We would suggest that this hose be permanently attached to the hydrant, and that a house be built over the same. The fire apparatus was called into use last fall when the roof was discovered to be on fire and the flames extinguished without difficulty.

There are seven watchman's boxes in different parts of the institution, which the watchman has to visit once an hour, between 9 o'clock in the evening and 5 o'clock in the morning.

The building used for the insane is not a suitable one. For these patients ten rooms, including a bathroom, were fitted up in the attic of a building occupied for the laundry and the woodshed. There are many objections to this plan, and we would suggest that the county take into consideration at the earliest practicable moment the need of erecting a new building for this class of patients.

The jail, so far as its sanitary condition is concerned, is in an excellent condition. It is kept thoroughly whitewashed and painted by the prisoners. It would seem, however, that the building is not a satisfactory one, judging from the report of the sheriff to the county commissioners. On this point he says:

"Our jail is not what it should be and its condition ought to be remedied at once.

"It is not to the credit of the county that the walls of this institution, made with an object to safely keep those committed to it, offer no more resistance to the efforts to escape, should those confined there be inclined to make it, than the walls of an ordinary dwelling house, those of wooden construction not excepted. Some of the cells are useless on this account.

"This matter ought to be fully understood, a thorough investigation made and the defects corrected.

"We also need bedsteads of different construction, that cannot be taken apart and used either as a weapon for assault or a tool for escape."

CARROLL COUNTY ALMSHOUSE.

Since our last report upon this institution some four or five thousand dollars have been expended upon it in improvements. Steam heating has been introduced, thus doing away with the numerous stoves which were a constant source of danger to the entire buildings. A forty-horse power boiler has been set in the basement, and steam from it is conducted to thirty-six radiators, conveniently and appropriately distributed, so as to heat all the rooms, including the attics. The radiators are of attractive pattern, and furnish an ample amount of heat, as the experience of the past winter has proven. The next, but no less needed, improvement consists in an excellent water supply, put in last year, and which furnishes water of splendid quality, and apparently in abundance for domestic uses and for fire purposes. Good springs were found about three fourths of a mile distant, a reservoir made, and an iron pipe, commencing with eight inches in diameter and ending with four, was laid to the buildings. Two out-door hydrants were put in, one on each side of the almshouse. To one of them two lines of fire hose are constantly attached ready for instant use. A four-inch standpipe goes up through the middle of the main house, having two-inch hose attached on every floor, including basement and attic, and sufficient in length to reach every room in the entire institution. The pressure is sufficient to throw water with great force over the main house, outbuildings, and barns, the reservoir being at an elevation of 112 feet. The house service is connected directly with the main pipe, thus doing away with the tank in the attic. Two ladders, reaching to the roof of the main building, are always in position and ready for use in case of fire. If the reservoir is of sufficient capacity it would seem that the protection now afforded for extinguishing a fire is all that could be desired. It is especially worthy of note that the standpipe and inside hose are large enough to be of practical use, a point overlooked in some other institutions of this kind.

The general condition of this almshouse is most excellent. All the rooms are whitewashed once and sometimes twice a year. In the matter of order, neatness, and cleanliness in all its departments this almshouse is not excelled by any in the state, for which especial commendation is due the matron, Mrs. Manson. The institution has sixty inmates, among which are fifteen insane and six children.

The county jail, connected with the almshouse, remains in the same condition, practically, as when last reported upon. It is entirely unsuitable for its purpose, and the county should take early steps towards the erection of a decent jail.

MERRIMACK COUNTY ALMSHOUSE AND ASYLUM.

This institution is located at North Boscawen, a very short distance from the railroad station. The main house is on an elevation overlooking the Merrimack valley and river, and some fifty or seventy-five feet higher than the asylum barns and other out-buildings, and at a considerable distance from the same. Indeed, this is one of the best located almshouses in the state from a sanitary point of view.

The drainage of all the buildings, even including the overflow from the water troughs at the stables, is conducted by sewers to the river.

The improvements at this institution since the large barn was erected some three years ago, are not extensive, although some of them are important. Among the latter may be mentioned the abandonment of the old water-closets and the substitution of latrines. The latter consists of an iron trough several feet in length, of ample depth, in which there is constantly a supply of fresh water. This water is supplied from a tank which automatically discharges into each latrine about half a barrel of fresh water every ten minutes. These latrines have been in use at this institution about a year, and have fully demonstrated that they are a great improvement over the usual water-closet, especially for institutions like this. There is an entire absence of odor from them, owing to the almost constant flushing, and therefore they have not at any time been a nuisance.

Some improvements in the plumbing have been made, including a few new sinks.

The dispensary has been changed and greatly improved by making a closet with glass panels across one entire side of the office, and in which is kept an ample supply of medicines for the institution. These medicines are all in attractive looking bottles permanently labeled.

In the basement of the south wing of the almshouse, a dining-

room has been prepared for use in winter, or such other times as it may be needed.

From a general standpoint, the institution is in a most excellent condition. Its walls are kept well painted and whitewashed, and the rooms and hallways are clean and tidy.

Constant improvements are always needed in institutions of this character, and this one is no exception. New hard wood floors ought to be laid in the hallways and corridors, bath-rooms, hospital, dining-rooms, and perhaps in some other portions of the main almshouse, to take the place of the defective, shrunken, and worn-out floors now existing.

Another thing which is needed in this institution is a general social room for the women, something equivalent to the men's smoking room upon the other side of the house. We would suggest that the space occupied in the basement by the laundry (which ought to be removed and which ought never to have been installed where it is) would make a good room for the purpose suggested.

The insane asylum, which was built a few years ago, and which has been described in some of the former reports of this board, is in a most excellent condition.

The general health of the inmates has been excellent during the year. At the time of the inspection (September 13) not a person was confined to the bed on account of illness.

The institution contained 150 inmates, including 17 prisoners and 46 persons classed as insane, 38 of whom are confined in the asylum.

HILLSBOROUGH COUNTY ALMSHOUSE.

This institution is located in the town of Wilton, some four miles from the railroad station, substantially on the top of a hill, which is much better situated for a summer resort than for a large charitable institution which must be maintained with exacting care year in and year out. It is, however, gratifying to be able to state that the great mistake made in selecting this location for a county almshouse, asylum, and workhouse, has been recognized and, urged by the imperative necessity of new buildings, is about to be abandoned, the county having purchased a new farm at Goffstown and already commenced the erection of new and substantial brick buildings.

The present institution has been most unfavorably reported upon

more than once by this board. The buildings are almost entirely of wood, built as cheaply as possible, unsafe in some particulars, and in constant danger of being destroyed by fire with great loss of life.

At the time of this inspection (June 12) there were two hundred and eighty-eight inmates, besides forty-one prisoners, making a total of three hundred and twenty-nine. At one time during the past winter there were over four hundred souls at this institution—an excessively overcrowded condition. About one hundred of the inmates belong to the insane class—72 women and some 30 men.

One of the noticeable features which appeals strongly to the humanitarian is the presence of some sixty children who ought to be brought up under conditions far removed from the object lessons of crime, vice, and immorality which they are now daily receiving in spite of the most careful training and watchfulness the superintendent and matron, with their assistants, can exercise over them. Although a law was enacted at the last session of the legislature allowing certain orphan institutions to take children from the county almshouse, not a single application has been made for a child. The superintendent, however, frequently finds a good home for some child in a reputable family.

The buildings have been painted during the past year so that to the eye they present a better appearance than for years. Inside painting has added much to the neatness and healthfulness of the rooms. They are kept clean throughout.

The water supply is inadequate although recently somewhat improved. During the past winter at one time water had to be hauled for domestic uses.

The danger from fire is a matter to which we have before called the attention of the county. Small streams of water from the stand-pipes might put out a fire in its first stages, but if it had got under much headway before being discovered complete destruction of the buildings with a large loss of life would probably follow. The superintendent is exercising all the precautions within his power to prevent such a catastrophe. A watchman patrols the premises from 7 o'clock in the evening till 4:30 in the morning, and officers sleep in every ward but one.

The general management of the institution appears to be excellent.

CHESHIRE COUNTY ALMSHOUSE.

This institution remains in practically the same condition as when last reported upon. It has about sixty-five inmates, eighteen of which are classed as insane, and four are prisoners.

No special improvements have been made during the last two years; the walls of some of the rooms have been newly painted. Some improvements are needed. Fire escapes should be placed upon the main building. The rooms in the attic now used for a house of correction should be abandoned *in toto*; it is not a suitable place for prisoners. The latter have to go through the main house to reach these rooms; they are illy constructed; in fact, they are to be condemned from every standpoint. If the county continues to send prisoners to this institution some other provision should be made for them.

We think it would be wise for the county to construct a small laundry building, and use the room now occupied for a laundry for the purpose of furnishing more room for the insane inmates.

It is certain that the county ought to take into consideration the suggestions herein made, and appropriate a sufficient amount of money to make the needed improvements.

SULLIVAN COUNTY ALMSHOUSE.

This institution, located in Unity, five miles from Claremont railroad station, so far as the buildings are concerned remains in practically the same condition that existed when our last report was made. Some improvements, however, of considerable importance have been made, to wit:

1. The water supply of the institution has been materially increased by connecting the reservoir,—which is situated on a hill ninety-three rods distant from the almshouse—with another spring. This addition has thus far given the institution ample water for all domestic purposes; but during the dry period of the present year it was drawn upon to the extent that only about one foot of water remained in the reservoir. While this condition continued some economy was practised in the use of the water.

2. The commissioners have endeavored to protect the buildings in a measure from destruction by fire, and to this end have erected a stand-pipe two inches in diameter in the main building, which

goes from the basement to the attic, and to which is connected upon the first, second, and third stories of the building a sufficient amount of hose to reach to all parts of the institution. There is a fall of 120 feet, which gives a pressure sufficiently strong to throw water over the entire building. This provision against fire would be of great service if a conflagration should be discovered in its incipient or early stages, but if it was well under headway it is not probable that the streams thrown from the two-inch pipe would be sufficient to suppress it. No provision has been made for an outside fire service, there being no hydrant or place to connect hose except the stand-pipe mentioned.

3. The sewer system of the building has been overhauled and relaid so as to give good service. Iron pipe was used throughout, and the sewage is now conducted to a reasonable distance away from the buildings. The soil pipe was extended through the roof of the main building so as to provide for the ventilation of the sewer.

In addition to the above mentioned improvements, the buildings were last year all painted throughout. They are kept in a most excellent condition. A degree of cleanliness prevailed throughout the entire institution which is exceedingly gratifying. Indeed, much praise is due to the matron for her efficient oversight and constant exertion to keep the buildings in the best possible sanitary condition.

The asylum for the insane, which is a separate building, might be taken as an example so far as neatness and cleanliness is concerned, by every similar institution in the state.

Not a patient is under lock and key through the day. Some of the patients that were formerly kept locked up now have their liberty almost entirely unrestrained. This condition has been brought about by personal interest in the patients and a constant effort to better their condition, the success of which has been very marked.

A stand-pipe has been constructed upon the first floor of this building with an ample amount of hose to reach to any part of it.

The institution is provided with two Babcock Chemical Fire Extinguishers.

There were present at the time of the inspection in August, sixty-three inmates.

GRAFTON COUNTY ALMSHOUSE.

This institution, which is located about two miles from Woodsville, upon a site most favorable to good drainage, upon the bank of the Connecticut river, while remaining substantially the same as heretofore, has received some important improvements during the present year.

The water supply has been largely increased. There is a reservoir which holds 45,000 gallons, supplied ordinarily with excellent spring water, but supplemented by a pumping station, which, when needed, can force water from the Connecticut river into the reservoir, which is situated at an elevation sufficiently high to give about 62 pounds pressure per inch upon the pipes at the almshouse. The supply from the springs is ordinarily sufficient for all purposes, so that it is only occasionally that the pumps have to be used.

Four out-door hydrants have been established, with 300 feet of hose for use with these hydrants. The pressure is sufficient to throw a stream of water 20 feet higher than the almshouse, and all the buildings can be reached with the water. The hose is $2\frac{1}{2}$ inch with 1 inch nozzle.

There is a standpipe inside the main building, to which is attached 500 feet of 1 inch hose with three-eighths inch nozzle, and with which all parts of the interior can be reached. The hose is attached upon each floor from the basement to the attic.

The hydrants upon the outside of the building are covered with a small house, with hose constantly attached and ready for immediate use.

No night watchman is at present employed, but it is the intention of the commissioners to engage one immediately.

The buildings, as a whole, are in a fair state of repair. The asylum for the insane needs to be changed in some respects. It is by no means well ventilated, and its general cleanliness is not of as high degree as it ought to be. The internal arrangement and construction of the building does not make it so easy to maintain as good sanitary conditions as are found in some of the similar institutions in the state.

At the time of the inspection in July the institution contained 107 inmates, 23 of whom were confined in the asylum for the insane.

COÖS COUNTY ALMSHOUSE AND ASYLUM.

At the last session of the legislature, the Coös county delegation appropriated $15,000 to repair the buildings and to erect a new building for the use of the insane, this class having formerly been kept in a building totally unfit for the detention of any person.

The instructions of the delegation have been carried out in a most commendable manner by the county commissioners. The almshouse proper has been overhauled from basement to attic. Throughout the entire building hardwood floors have been laid, and the entire walls and overhead have been sheathed with kiln-dried bass sheathing in all the rooms and corridors—the walls are well varnished and overhead painted in tints. No plastering or paper is to be seen. This method of construction has the merit of utility and cleanliness. The locks have been changed so that one key opens every door in the building. New stairs and partitions have been constructed so as to divide the sexes. An office has been made in the main house.

The building is heated throughout with steam. Three chimneys formerly used for stoves are now used for ventilating flues.

A stand-pipe has been put in, extending to the top of the building, and hose connected with each floor for protection against fire. Hose is permanently attached to this pipe on each floor.

There is a bath-room and water-closet in the basement for men, and a like service on the second floor for the women. The closets are automatically flushed, and the bath-tubs are supplied with hot and cold water.

New sinks have been put in the kitchen, and this department placed upon a first-class basis.

The entire drainage system has been overhauled and put in good condition. The sewage has been discharged into the Connecticut river.

The new asylum for the insane, now completed and occupied, is a wooden building 34x64 feet on the ground with a projecting front 7x20 feet, two stories high, with a large basement. The latter is used for pipes and flues for heating purposes.

Each room is heated by indirect radiation. The rooms are also supplied with water-closet, and each has a ventilating flue.

There are twenty-four rooms on the two floors and four rooms in

the attic that might be used in case of necessity. There is a bath-room on both floors, also ample corridors and sitting-rooms. A room has been made in the attic for infecting and fumigating purposes in case such is needed.

The building has a stand-pipe to which is constantly connected a sufficient amount of hose to reach to every part of the building.

The floors are entirely of hard wood, and the walls and ceilings finished in bass sheathing, well painted and varnished.

In addition to these improvements, a new 75 horse-power boiler has been put in for heating purposes in a building some 75 or 100 feet distant from the asylum or almshouse.

A chimney 9 feet square at the base and 75 feet high has been erected. There is no fire either in winter or summer in the asylum and the commissioners are soon to put in incandescent electric lights in place of kerosene lamps, so that after this improvement is made there will be absolutely no fire about the building.

The water pressure is sixty pounds to the inch. From a hydrant outside water can be thrown over all of the buildings, regular fire hose being used.

In July of the present year the institution had only 58 inmates, a smaller number than usual.

The general appearance of the institution at the time of the inspection was most excellent. In fact, it was hardly recognizable as the old Coös County Almshouse, so much have the improvements changed its appearance. The county is to be commended for the work it has done in the direction indicated, and much credit is due to the commissioners for their promptly carrying out the recommendations of the county delegation.

N. H. ASYLUM FOR THE INSANE.

The superintendent respectfully submits a report of the New Hampshire Asylum for the year ending September 30, 1894.

The year commenced with 368 patients—176 men and 192 women.

The number admitted during the year was 187—92 men and 95 women.

The number of different persons treated during the year was 542—264 men and 278 women.

The mortality rate for the year was a fraction over six per cent. Out of the large population cared for no suicide or other serious casualty occurred.

The percentage of recoveries, based upon the number of *different* persons admitted and excluding all cases of alcohol or opium habit, was 27.68 per cent.—a gratifying slight increase upon that of the previous year.

During the past year the population at the asylum has increased much more rapidly than in previous years. During the past decade there has been an average yearly increase of eight patients. The increase, however, for the last year was larger than ever before.

On the first of October, 1894, there were 402 patients. This remarkable increase has strained the capacity of the present buildings to their utmost, and leads the superintendent in his annual report to emphasize the necessity for new buildings.

During the last decade two buildings have been located at the asylum, one the Bancroft building for convalescent women, and the other a new building for convalescent male patients, as yet unnamed, in process of erection. When this new building is completed, the asylum will have accommodations for 350 patients.

There will still therefore be over fifty more patients than there are accommodations.

The two buildings above referred to, while they are models of their kind, are designed for only a special class of patients, the convalescent and the appreciative insane, the number of which at any one time is comparatively small. Thus it happens that while the classification of certain forms of mental disease has been facil itated by the erection of these buildings, the congestion in the wards for the chronic and the acute insane has not been materially relieved.

Judging from the census reports, and from the steady increase of insane patients at this asylum, the inference is reasonable that insanity, as a disease, has not increased, but that the number of insane in the state have increased in proportion to the increase of population.

It is to be hoped that this increase in the population of the state may continue rather than decrease, being as it is an evidence of the material prosperity of New Hampshire. This average yearly increase among the insane, however, emphasizes the fact that the state ought to provide additional accommodations for this increase.

At the present time the New Hampshire asylum is suffering from the evil effects of overcrowding. There is an absolute lack of sleeping accommodations and dining room facilities. Every patient that is admitted in excess of the accommodations must be located either where his own influence upon others, or that of others upon him must be injurious. The attention of the trustees is therefore very properly called to this demand for additional accommodations.

The New Hampshire asylum was originally intended to be the remedial institution of the state, and during the past four years the State Board of Lunacy has regularly committed to the institution all cases of acute and recent insanity whose support would devolve upon towns and counties, and whose cases seem to require remedial treatment. If the humane work of this board is to continue, and if the institution is to maintain its remedial character, increased accommodations must be provided.

The new building in process of erection is designed to accommodate twenty-five men of the convalescent and appreciative class. Work was begun in the spring, and has been pushed forward as

rapidly as circumstances would allow. It is connected by a subway with the main building. Through this underground passage the food will be taken from the main kitchen to the building, and the hot and cold water and steam pipes from the boiler house will also be contained therein. The style of architecture is of the colonial mansion house type. There is a large central living room on each floor, lighted from a wide skylight, and the individual sleeping rooms are arranged around the outside, thus giving plenty of air and sunlight to the occupants. When completed it is confidently believed that there will be no pleasanter house for the convalescent insane in the country.

During the season the Walker convalescent cottage at Lake Penacook has continued its good work. From twenty to twenty-five patients have occupied it throughout the warm months.

DISPOSAL OF HOUSEHOLD WASTE.

The disposal of domestic garbage, especially the waste from the kitchen, is a question which has long perplexed and is still perplexing cities, towns, and individuals. Many methods have been attempted, some of which have met with immediate failure, while others are more or less successful when applied to cities under the general management of a special department; still the problem is one which has not been definitely settled. Processes for the utilization of certain products which are found in garbage have been tried with different degrees of success; cremation furnaces have been employed in many cities with varying results. None of the methods in use have yet solved the problem in a satisfactory way; there are objections to every system of greater or less magnitude.

Whatever work has been done in this direction upon anything like a systematized plan, has been accomplished only through the efforts of municipalities at the expenditure of large sums of money. In some cities the cost of collecting and disposing of domestic garbage aggregates a very large amount of money, and even then the service is not as efficient as it ought to be.

This great subject has been under consideration for several years by sanitarians in all parts of the world, so important is the question of preventing disease producing nuisances from becoming widespread through the neglect of individual families properly to dispose of the household waste.

A committee of the American Public Health Association has this subject now under consideration, and at the recent meeting of that association, in Montreal, a preliminary report was made by the committee. This report deals with many methods of garbage disposal, as well as of the character of city refuse and its collection and removal to the place of disposal. The committee, after reviewing the entire subject, closes its report as follows:

At the present time it can only state: That there are several ways of disposal which have been and can be made satisfactory from sanitary points of view; that cremation of garbage is at present in the lead, so far as the number of applications and the character of results are concerned; but that it has not everywhere been entirely satisfactory in both economical and sanitary respects.

This probably is a correct statement of the situation of the garbage question at the present time as applied to the corporate efforts of cities to solve the problem of its disposal.

When the report of the committee came up for discussion Dr. Samuel H. Durgin, chairman of the board of health of Boston, said:

I want to show to the association photographs of a recently invented kitchen garbage dryer, and will occupy but a few minutes in explaining its use. It is well known to the association that I have entertained the belief for some years that all kitchen garbage should be disposed of in the kitchen before it becomes a nuisance, and thus avoid the disgusting odors and expense which attend the present methods of handling. It consists of a perforated sheet-iron basket, with a tight bottom, and a capacity of three or four quarts. It is inserted into an expanded section of the stove-pipe, a short distance above the stove, and allows the hot air and smoke to pass on all sides of the basket. It is easily withdrawn from its position and replaced with one hand. It will receive the garbage as it occurs several times a day, and needs to be emptied but once in twenty-four hours. The garbage dries to a charcoal without burning, and becomes an excellent fuel for kindling the fire in the morning. It does not compromise the use of the stove, interfere with the draft, require more fuel, or cause any odors.

While considering its sanitary advantages, we should not forget the financial side of this question, for it is costing most cities more money to perpetuate the kitchen garbage nuisance by present methods of storage and removal than for the maintenance of their entire health departments. In my city of 500,000 inhabitants it cost the city last year for collecting and hauling away the kitchen garbage alone $182,000, and this sum must be increased yearly, without taking into account the additional cost of a public cremator or reducer. I have nothing to say against the large public crematory for the general rubbish and wastes of the city, which always contain more or less garbage; I believe that this general mixture, excluding kitchen garbage, can and should be burned, and its ashes put to the uses of clean gravel. I will pass these photographs around, and say that they represent one which I have had in use in my house for the last two

Garbage Drier Open, Showing Perforated Sheet-Iron Basket.

Garbage Drier Closed.

months, and which absolutely disposes of the nuisance and expense of handling kitchen garbage.

The one in use in my house, the only one yet constructed, was invented and made by Messrs. Taylor & McLaughlin, at 120 Fulton street, Boston, and was the result of a short talk with them about two months ago. I am told that the cost will be about three to five dollars.

The photographs alluded to have been reproduced in half-tone, and are here given in order to illustrate the simplicity of the dryer as well as the readiness and ease with which it can be managed.

The first illustration shows the waste-holder nearly withdrawn from its receptacle. It may be taken out and filled with the kitchen waste of any kind or character capable of being destroyed by fire when dry, and at once placed in the pipe there to remain until its contents are thoroughly dried, after which all the material which it contains is to be dumped into the fire in the kitchen range or stove. It would seem that no simpler or more efficient and convenient method of disposing of the waste of the individual kitchen than this plan can be devised. Every one knows how quickly and readily the garbage box or barrel becomes a festering nuisance, especially during the warmer months of the year. With an apparatus of the kind illustrated, there would be no need whatever of the garbage barrel, and thus an offensive and dangerous nuisance may be easily prevented.

The second illustration shows the receptacle with the waste in its proper position for drying. The water which the waste contained, when placed in the receptacle, is rapidly carried off in the form of steam or vapor by the chimney, and no odor or other objectionable feature is connected with it. The flat top, which may serve for a hot shelf, readily suggests the uses to which it may be applied.

It looks as if this method is a perfectly feasible one, simple in all of its operations and pre-eminently designed to solve the question of the disposal of kitchen waste wherever it is used.

In considering this method of the disposal of household waste, Col. W. F. Morse of New York, who has given the subject a great deal of attention for the past few years, says: * For several years there have been efforts made to introduce attachments to stoves

* The Sanitarium, April, 1895.

that would care for waste in a cleanly way, and which would do the work required and not be troublesome to operate. Most of these inventions proceeded upon the plan of burning by a hot fire garbage containing water in suspension, insisting that this should burn from the bottom upward with a down draught, thus reversing the natural law of combustion, and failing in the effort to do by main force what could have better been done by a little attention to obvious facts. Other methods deposited the garbage in the end of the fire-box or at the back of the oven, where the space was limited, and from which it had to be transferred to a bright fire to consume it. None of these inventions have been found to be practical or have met with favor.

The Houshold Carbonizer proceeds upon a different plan. Recognizing the fact that household waste, when dried, will burn freely, and when carbonized or turned into charcoal can be used for fuel, this invention first places the garbage in a position where the water is driven off and the residuum transformed into a substance that will not only burn without extra fuel, but can be utilized as a new fuel or as a means of beginning a new fire.

In the joint of pipe or elbow that makes the connection between the stove or range and the chimney flue is placed a horizontal cylinder, somewhat larger in diameter than the pipe or elbow, and in length about twice its diameter. One end of this cylinder is removable, and attached to the inside of this is a basket or scoop, made of perforated iron a little shorter and smaller than the cylinder itself. The area of space around the basket is equal to the area of the pipe from the stove, so there can be no obstruction to the draught.

When the carbonizer is to be used, by means of a handle the cylinder-head and basket are withdrawn and the scoop filled with garbage and replaced. Small quantities of liquid are retained in the bottom of the scoop, which is not perforated. The heat from the fire passes around the basket and through the perforations, driving off the water, and chars the garbage into charcoal; the basket is then withdrawn and its contents emptied into the fire, burning with a clear, clean flame without offensive smoke; or the charcoal may be left until morning, and with the addition of a bit of paper and a stick of kindling wood used to start a new fire.

This operation of driving off the water by slow heat at a mod-

erate temperature does not disengage the noxious gases that are thrown out when the green garbage is placed in a hot fire; and as this work of evaporation is done in the smoke-pipe, there is no chance for escape of odors or vapors into the room.

The convenient location of the carbonizer permits waste to be put at once into the scoop as fast as produced, saving steps for the servants and preventing any accumulation of offensive matters.

The carbonizer can be put into the place of a joint of pipe of any size; or, if the height is not enough for a joint, can itself be used as the elbow or chimney connection. For set ranges arrangements can be made to connect with the chimney flue. For large houses, restaurants, hotels, etc., where the quantity of waste is large, the carbonizer assumes a rectangular shape, is vertical instead of horizontal, is enlarged to the capacity desired, and provided with sliding doors or covers which receive the garbage. The scoops or baskets are not removed; but the garbage, after being carbonized, is discharged through small doors at the bottom. The operation is continuous and requires no attention except to remove the charcoal and destroy it.

There are several sizes of the carbonizer, from the smallest, designed for a single family, up to the largest, destroying three or four barrels of waste per day. It may be made to correspond in style with the general fittings of the most expensive range, or built in an inexpensive way and sold at a small price.

This device is not merely a paper invention. For eight months it has been thoroughly tested and found to perform the work as above described. In houses where the carbonizer is used there is a notable absence of the garbage can, and the visits of the garbage collector are not required. It is absolutely a perfect substitute for those disagreeable household attachments, since there is nothing produced that cannot be turned into charcoal by the carbonizer excepting ashes from coal fires, tin cans, and broken crockery, and these are delivered to the weekly ash collector free from any contamination of putrescible matter and in perfect condition to be deposited anywhere without subsequent nuisance.

If it were possible to apply this or some similar invention on a large scale by legal ordinance, it would stop the carting of garbage through the streets, abolish the garbage dumps, do away with all sea dumping and water contaminations, save tremendous sums of

money, and bring peace and happiness to the souls of the city officials, whose duty compels them to collect and dispose of this vast bulk of dangerous and disease-breeding matter.

This practical, inexpensive sanitary invention is a contribution to the progress of sanitation, which is not equalled by the more pretentious and costly disposal methods heretofore in use. The simplicity of the device, the ease with which it can be applied, and the satisfactory way in which it does its work commends it to the attention of those who are looking for some relief from the garbage nuisance.

AMERICAN PUBLIC HEALTH ASSOCIATION.

REPORT OF THE TWENTY-SECOND ANNUAL MEETING AT MONTREAL, P. Q., SEPTEMBER 25-28, 1894.

BY G. P. CONN, M. D., PRESIDENT OF THE NEW HAMPSHIRE STATE BOARD OF HEALTH, CONCORD, N. H.

The meeting was a large one and the members devoted their time zealously to the work that was before them, therefore the number of papers read and discussed compared favorably with past meetings. All the northern and western states were represented, and most of them in the south. The Dominion of Canada was well represented, and the Republic of Mexico sent a good delegation.

The objects of the American Public Health Association, and the nature of the composition of its membership, are such as especially to commend it to the favorable consideration of an intelligent community.

Its object is not so much the cure of disease as the prevention of it. By the investigation of the most recent findings in sanitary science, and by the dissemination of the information thus acquired, it seeks to improve the definition and enforcement of the laws of health wherever men are gathered together on this continent. Its membership, therefore, is not confined within the limits of the medical profession, but includes all who desire to forward the object of the organization.

The Association has already published nineteen large and valuable volumes, increasing at the rate of one a year, and containing

the papers, reports, and discussions presented at the annual meetings. These volumes constitute in themselves a library upon sanitation; they are elegantly printed and bound, and are alone worth more to any person interested in hygiene than the cost of membership.

Among its members may be found physicians, lawyers, ministers, civil and sanitary engineers, health officers, teachers, plumbers, merchants, etc.,—in fact, every profession and many of the industries are represented in its list of members.

A gathering of this character requires more labor and diplomacy than some people think. The range of subjects connected with public health is exceedingly wide, and there is a danger of some members of the association dragging it outside of its proper province. Most of the questions to be dealt with have a professional, as well as a popular side, and it is difficult to deal with some of them in a scientific manner without using terms and methods unfamiliar to the lay mind. Those who have had charge of the papers this year have solved this difficulty with considerable success. They have conveyed the results of the most recent scientific research in an interesting and intelligible form, and there has been a careful avoidance of unnecessary technicalities.

It is impossible in a report like this to follow the whole programme and therefore I should only select from its numerous papers such as have special reference to this locality.

During the first session of the Association, a paper was presented entitled, "The Cart before the Horse." This paper was read by Dr. Benjamin Lee, secretary of the State Board of Health of Pennsylvania, who said in part:

"When those who speak the English language desire to characterize a line of thought or of procedure as being in the very highest degree ridiculous and absurd, they make use of the word, "preposterous," a word which they have had handed down to them from the days of ancient Rome; for the Roman with his strictly logical mind could conceive of nothing more grotesque and idiotic than placing that which should properly and reasonably be *pro—before*, whether in relative position or in sequence of time, *postero—behind* or *after*. The Saxon, with his love for the concrete and his fondness for epigram, crystallized the thought into the proverbial expression, "the cart before the horse." I know of no more forcible exemplification of this

trite but useful old adage than the absolute reversal which we so constantly find of the appropriate relative positions in point of time of the introduction of water supplies and the provision of systems of drainage. The first thought of the citizen who proposes to build himself a country residence is beauty of location. The second, architectural adornment. The third, possibly, a copious and pure water supply, and, with this, modern plumbing follows as a necessary accompaniment. Last of all, he or his architect bethinks himself that it will be necessary to find a receptacle for this considerable stream which he is going to divert from its natural course and fill with the accumulated filth of his household. That which should have been most carefully considered first, before a line was drawn or a plan designed, is left to be provided last, in some hap-hazard way, as if it were a trifling detail of no moment whatever. The problem may prove impossible of satisfactory solution to himself. Or if provision can be made in such a way as to relieve himself of annoyance, the chances are ten to one that his neighborhood will begin to complain of the flooding of his yard or the pollution of his well; or, what is still worse, and unfortunately of undoubtedly frequent occurrence, sickness may be created in families more remote, the cause of which is unsuspected and therefore unremoved.

The little towns among the hills and mountains of Pennsylvania are peculiarly fortunately situated for the production of an abundance of pure water. The municipal authorities of these towns are besieged by water supply contractors, generally from New England, and therefore having no local interests in the town, with offers to introduce water on very advantagous terms. The temptation is great and is often yielded to before a single rod of sewer pipe is laid in the streets. Then the "practical" and "sanitary" plumbers get in their fine work. Every ambitious citizen must have water all over his house with all the modern appliances. The kitchen water even though in greatly increased quantity may pass off over the surface and through the street gutters. But what shall be done with that discharged from the water closets? Happy thought! He no longer depends on the old family well for drinking water, so, into that, the soil pipe is incontinently discharged. So far so good. It does not annoy him. But he does not reflect that the same subterranean stream which supplies his well in all probability supplies those of the entire neighborhood. It can be readily understood how that which should have proved to be an inestimable blessing to the community may thus inadvertently be converted into a terrible calamity. Even in gravelly soils, where opportunity for filtration to a considerable degree exists between neighboring wells, this danger is a most serious one. It will easily be seen how

much it is aggravated in limestone regions where the water courses along underground for great distances, almost unobstructed. And yet it is just under these circumstances that the temptation to avail one's self of this so-called natural drainage is the greatest. The object of this paper may be briefly embodied in the two following propositions:

1. Copious water supplies, with the aid of what is known as modern plumbing, constitute a means of distributing fecal pollution over immense areas through the soil, through subterranean water courses and in surface streams, and can not therefore be regarded with unmodified approbation by the sanitarian.

2. The question of drainage and sewerage whether for individual residences or for communities should always precede that of water supply; and no water-closet should ever be allowed to be constructed until provision has been made for the disposition of its effluent in such a manner that it shall not constitute a nuisance prejudicial to the public health.

THE WELL WATERS OF OUR FARM HOMESTEADS,

was read by Frank T. Shutt, Chief Chemist Federal Experimental Farm, Ottawa. The subjoined is a brief synopsis:

The purest water is undoubtedly to be found in the country, and it is a necessity for farm animals as well as for man to have pure water, that milk from healthy milch cows may be wholesome and that butter and cheese may be likewise. Clay soils are more or less impervious to the absorption of filth, and in this we should be careful from a hygienic standpoint. Regarding the qualitative tests for diagnosing water, the writer thought no correct inference could be drawn from the sugar, nitrate of silver, or permanganate of potash test. The remainder of the paper consisted in a cursory review of wells and their environments, and directed attention to the fact that much impure water is consumed in the country with serious and often fatal results, and pointed out the principal lines upon which corrections should be made and a reform brought about: "As the agriculturalists form a very large proportion of the population, I think it well that we who take an active interest in the health of our people should endeavor to disseminate through the country knowledge regarding the injurious effects of impure water, and the precautions necessary to be taken if pollution of the well is to be avoided. I have no doubt that one of the beneficial results of this convention will be a keener and better and more intelligent understanding of this vital subject, an understanding

that will lead to purer water and better health upon our farm homesteads."

Dr. Fuller, bacteriologist in charge of the Lawrence experiment station of the State Board of Health of Massachusetts, after fully describing the filter of sand used and the results obtained in that city, gave the following conclusions:

During the five years preceding the use of the filter, the average annual death rate from typhoid fever in Lawrence was 1.27 per thousand inhabitants. The population of Lawrence is 50,000, and this average rate is equivalent to sixty-three actual deaths per year from the disease. During the past year there have been twenty-six deaths from typhoid fever in that city, a reduction of 60 per cent. Of the twenty-six who died, twelve were operatives in the mills, each of whom was known to have drank infiltrated and polluted canal water, which is used in the factories at the sinks for washing. Among the operatives of one of the largest corporations where canal water is not used, there has not been a single case of typhoid fever during the past year.

The test of the efficiency of the filter during the past year has been a fair one, because at Lowell, the sewage of which enters the Merrimack river nine miles above the intake of the Lawrence filter, there was, during the past winter, a severe epidemic of typhoid fever.

In conclusion, we may state that it has been found practicable to protect the consumers of infected water supply by means of sand filtration.

At the afternoon session Dr. J. D. Griffith of Kansas City, Mo., read a paper on the "Innocuous transportation of the dead." He opened by quoting instances where epidemics were renewed by the exhumation of bodies after years passed underground, and concluded that the danger from one just deceased from a contagious disease must be much greater. It matters not how tight the coffin may be, there is always an odor emanating in the car where there is a body. Hence, the necessity to protect the travelling public. To do this he did not think that the existing rules are sufficient, and he advocated that a special compartment be prepared and set aside on baggage cars for the transportation of bodies. This compartment should be lined with zinc and asbestos and covered with ice.

Dr. Hingston said that the bodies of people who have died from infectious diseases are not allowed to leave Montreal, and on general principles the transportation of dead bodies should be put a stop to.

This sentiment met the general approval of the meeting, and finally on motion of Dr. Bryce it was decided to refer the whole matter to a special committee.

The evening session of the first day was held in Windsor hall, and was devoted to a formal welcome to the Association by the Dominion and municipal officers, and closed with the annual address of the president, Dr. E. P. Lachapelle, of Montreal.

The address of welcome by the mayor is quoted in full:

To the Members of the American Public Health Association:

LADIES AND GENTLEMEN: Permit me, on behalf of the citizens of Montreal, to extend to you all a most cordial welcome to our city. You have assembled here to hold the twenty-second annual meeting of your organization, and I assure you our city considers itself honored by your presence.

Your association, considered in its objects and in the result of its labors, is one of the most important on the American continent. Favor by every possible means the progress of science in matters of hygiene; see that everywhere practical measures are adopted to prevent sickness and epidemics; these are the objects of your association, and one cannot but acknowledge that such objects are noble, useful, and humane.

The all importance of public and private hygiene is now admitted by everyone, and no person will deny that both these branches of medical science are very closely connected. They are connected not only with the health and welfare of the universe, but as well with the commercial and financial condition of cities and countries. The sanitary and commercial interests of the world are dependent upon one another, because when an epidemic breaks out, commercial transactions are stopped at once, misery and hardship are the consequence, and who will deny that misery gives birth to sickness? It is, therefore, with reason that hygienists give their undivided attention to the commercial interests of the world, because when these are prosperous public health is sure to derive great benefit therefrom.

Your association possesses an especial character of philanthropy and universality, because all its efforts tend towards the preservation of humanity from sickness and contagion. Such devotedness to the interests of your fellow citizens is worthy of admiration, and for that

reason alone I might consider myself especially honored at being called upon to bid you welcome to Montreal.

I, therefore, pray you to consider yourselves at home in our city, the commercial metropolis of Canada, and I sincerely trust that your convention will be fruitful, and will result in doing good to yourselves as a body and to the community at large.

You may rest assured that one and all of the citizens of Montreal appreciate fully the honor you have done them in selecting their city as the scene of the present convention, and that, whatever destiny may have in store for you, the good wishes of our people will always accompany you.

Dr. Gregorio Mendizabal, of Orizaba, Mexico, briefly addressed the gathering in Spanish. He referred to the commercial depression in Mexico consequent upon the financial crisis, and said that this had prevented some of the Mexican delegates, who had been anxious to be present, from coming here. However, realizing how important was the convention, it had been decided to send some one, and therefore he and one or two others were present. After alluding to the unspeakable pleasure it gave him to contemplate the mighty St. Lawrence and this great country, he referred to the "colony" of Hochelaga, which had developed into a great city, a city that was worthy of being the capital of any country in the world, a city whose name had become world-renowned, as well on account of its commerce as of its literateurs and poets. Speaking of the American Public Health Association, he said that science knew no country; the salvation of the people was the supreme law. The members of the association in their work were laboring as much for material progress and prosperity as for anything else, knowing that a sound mind was essential to a sound body.

THE PRESIDENT'S ADDRESS.

The president was loudly applauded on rising to address the gathering. In the course of his remarks he said that the Association had never, since its foundation, ceased to labor for the advancement of sanitary science, for the promotion of measures and organizations that should effect the practical accomplishment of the laws and principles of public hygiene. It had thus realized the brightest hopes and the most enthusiastic provisions of its worthy founders, and had extended its benefits and influence over the whole of

North America, the Republic of Mexico, and the Dominion of Canada, all three working together in brotherly emulation, recognizing no political boundaries, and valiantly striving to attain one unique and humane object—the dissemination to all of the knowledge of public hygiene and the development of respect for its decrees. He spoke of the causes which had led to the great progress in sanitary science on this continent during the last twenty years, referred to some of the important things which yet required to be considered, and concluded as follows: "The perspective of the future is very encouraging. The work done during the last fifteen years has been enormous; what may we not then expect of the next fifteen years? All over the continent, state, provincial, and local boards of health have been organized, and are working effectively; associations, conferences, and conventions are studying the most actual and urgent problems of public hygiene; everywhere, already, a prominent position is given to the teaching of sanitary knowledge; universities and schools obtain the services of competent and distinguished teachers, and are being rapidly equipped with laboratories of sanitary science; every city or district will soon have, if it has not already, its municipal laboratory worked by competent specialists. The practical scientific working is now created and advancing. The generation that succeeds us, luckier than we in this respect, will be in possession of all that is needed to ensure success. We shall drop out, wishing them courage and perseverance, and be happy if we can claim to have contributed according to our means to prepare the way for them and render less ungrateful the task we bequeath them. Without fearing to counteract the designs of God, we may continue to utilize the talents He has given us in seeking the best means of protecting our health and lives, and of attaining the average of longevity. Without wishing to frustrate the decrees of His supreme justice, let us not forget that contagious diseases and epidemics, although they may in a measure serve as punishment for the waywardness of man, are most frequently the outcome of his errors and ignorance in the preservation of his health, and, as such, they should be struggled against. The protection and preservation of one's health and that of one's fellow beings is not only a right, but a solemn duty."

On the motion of the lieutenant-governor a vote of thanks was accorded Dr. Lachapelle for his address and for his labors on behalf

of the association, the gathering closing with the playing of "God Save the Queen" by the orchestra.

MORNING SESSION.—WEDNESDAY.

The greater portion of the morning session of the American Public Health Association was devoted to the reading of papers on that white plague of humanity, consumption. Every phase of the subject was discussed, and some valuable information for the general public, as well as the medical man, was imparted.

Dr. N. E. Wordin, of Bridgeport, Conn., showed that consumption was an infectious or communicable disease, and that the principal source of danger of its spreading lay in the sputum ejected by a pthisical patient when it had become dry.

He considered that the most practical and the quickest way of restricting the spread of tuberculosis would be to put it on the list of infectious or communicable diseases to be reported to the health officers. There should be a thorough disinfection of all houses in which the disease had occurred, and this should be put on a public record. There should also be a disinfection of hotel rooms, sleeping car berths, rooms, and prison cells which had been occupied by consumptives before they were occupied by any other person. Transportation companies should be compelled to thoroughly disinfect cars and bedding under the superintendence of the board of health of each state as they come within its borders.

No tuberculous female, he said, should nurse a child; milk from tuberculous animals should never be used; overcrowding in houses should be prevented; consumptives should never spit upon the floor of any public or private building, or any conveyance; the sputum should be immediately burned; beds, bedding, and clothing used by consumptives should either be disinfected by steam, or washed and boiled by themselves; no one should sleep in the same room as a consumptive, or in a room which has been occupied by a consumptive until it has been thoroughly disinfected; milk should be thoroughly sterilized before being served to children; there should be public inspection of dairies and slaughter-houses; milk should be tested for tuberculosis, so that the disease might be stamped out in cattle; the general hospitals should be provided with special wards for phthisical patients, and in them should be enforced the proper measures for the elimination of infection.

Dr. F. O. Donohue, president of the New York state board of health, contributed an able paper on "Examination of the Milk Supply for Tuberculosis in the State of New York," in which he detailed what had been done in this direction.

Dr. Paul Paquin, member of the state board of health of Missouri, submitted a very thoughtful contribution, in which he discussed the question, "Should the Marriage of Consumptives be Discouraged?" and gave several conclusive proofs in support of the affirmative.

Dr. Sewell of Denver read a paper on "The Climatic Segregation of Consumptives," in which he gave a special boom to Colorado.

The committee on restriction and prevention of tuberculosis reported progress, and asked to be continued another year.

A general discussion on the papers dealing with tuberculosis then took place, and at its close an adjournment was made for luncheon.

The afternoon was devoted to pleasure, the members of the Association, many of whom were accompanied by their wives and daughters, taking in the trip which had been arranged down the Lachine rapids. Needless to say, everyone enjoyed it, and it was a feature of the convention which will long live in the memory of the visitors.

THE EVENING SESSION.

The Association resumed its sessions in the evening, when Dr. F. Montizambert, general superintendent of Canadian quarantines, contributed a very interesting paper on "Quarantine Appliances," which was illustrated by means of a number of lantern slides. He began by explaining that, although the title of his paper would seem to limit him to appliances only, he was sure that, in view of the visit to the Grosse Isle Quarantine station which had been arranged, it would be of general interest if he also showed some views of other parts of buildings at that station, so that when the delegates arrived there they would the more clearly understand the working of the different parts of the system.

HYGIENE OF THE YOUNG.

Dr. J. C. Cameron, professor of obstetrics and diseases of children at McGill College, submitted a very practical contribution on "Some Points in the Hygiene of the Young in Schools," which was illustrated by means of a number of diagrams. He pointed out that mind and body were dependent upon each other, and consequently for the proper development of the individual the body must be considered and cared for as well as the mind. He referred to the fact that the physical culture of school children was in too many cases not properly cared for, though in the case of boys, who engaged in outdoor sports, etc., the effects were not so marked as in girls, who indulged less in outdoor sports and were inclined to be more sedentary. Spinal curvature and pelvic deformity, he showed, were liable to result from assuming an improper attitude when sitting, standing, or walking, and consequently it was of the utmost importance that school children should be taught to sit, stand, and walk properly. Pointing out what he considered were some of the things what might be done to improve the personal hygiene of the young in schools, he said that for training young children the kindergarten system was an ideal plan, and then came the simpler calisthenic exercises.

In high schools and colleges a careful examination should from time to time be made of the physical condition of the pupils, and such courses of exercise prescribed as were suitable for their needs. Hygiene should be one of the subjects of study in schools. In large cities a valuable addition to the school staff would be an inspector of physical culture, to whom could be referred any suspected case of spinal curvature or pelvic deformity for examination and treatment. Youth was the time and school the place for the detection and cure of irregularities, whether physical or mental.

MORNING SESSION.—THURSDAY.

The following resolutions were introduced and referred to the executive committee, by E. R. Campbell, M. D., of Bellows Falls, Vt.:

Resolved, That the American Public Health Association in convention assembled records its protest against the use of alcoholic liquor as a beverage, especially among the young, believing that such use is attended with great danger to the health, the individual, and society.

The following resolution, moved by Dr. Henry Sewell of Denver, Colorado, was also referred to the executive committee:

Resolved, That a committee consisting of not more than five members be appointed by the president of the American Public Health Association to consider the best form of sanitaria for consumptive invalids, and the most favorable locations for the same within the United States, the report of the committee to be made at the meeting of the Association held in 1895.

Dr. George Homan of St. Louis, Mo., offered the following resolution:

WHEREAS, It is the sense of the American Public Health Association that the pollution of potable waters in America has reached such a point that the national governments should be asked to take cognizance of the matter with the view of devising means of prevention and relief; therefore, be it

Resolved, That this Association memorialize the congress of the United States and ask that they shall authorize the appointment of a competent commission clothed with power to fully investigate the whole subject of the pollution of rivers and lakes by municipal and manufacturing waste, and provided with sufficient means to enable them to conduct the examination in such manner as shall be deemed best, the results of said examination to be published from time to time for the public information.

Dr. Ralph Walsh of Washington, D. C., read a comprehensive paper on "Vaccine and Vaccination." He advised physicians to vaccinate children first at the age of six months and again at sixteen years, or better still to continue vaccinating the young infant up to the point of saturation, when the child would become absolutely impervious to either chicken-pox or small-pox. The doctor maintained that there is absolutely no danger in vaccination so long as the vaccine is pure and the operation properly performed. To secure proof that the patient was vaccinated to the point of saturation he would vaccinate at six months of age, or earlier, and then each succeeding six months until no result is obtained, making test re-vaccinations at intervals for a few years thereafter. The lymph should be used direct from the propagator, holding him responsible. The lecturer concluded that so-called cow-pox is simply modified variola. The admixture of glycerine with vaccine lymph not only destroys the extraneous bacteria, but prolongs the activity of the lymph. The selection of lymph and the simple but important operation of

vaccination has not received from the profession the attention deserved. The accumulation of unvaccinated material and consequently the increased danger of outbreaks of small-pox is caused by the general practitioner neglecting to perform his duty at the proper time.

Your delegate presented a report for the committee on car sanitation, which is printed in full in this report.

A report of the Montreal meeting would be very incomplete without mention of the excursion of its members to the quarantine station at Grosse Isle. The Association is under obligation to the municipal government of Montreal, who through Dr. Lachapelle gave transportation and every attention to the members. It is about two hundred miles from Montreal to the quarantine station, and the trip took about forty hours, allowing a stop of five or six hours in the beautiful city of Quebec.

It may be said that two or three years ago, considerable comment was made regarding the inefficient condition of the quarantine of the St. Lawrence river, and it was not at that time considered by sanitary authorities to be equal to the necessities and progress of the times.

Nevertheless those who went to Grosse Isle Saturday with the members of the American Public Health Association could not see much on the island that was in existence two years ago, beyond a few sheds for immigrants. All the principal buildings and the appliances for disinfection have been erected since that time. The extent of the improvements may be judged by the fact that the Ottawa government has found it wise to spend no less than a hundred thousand dollars on the station since the newspapers called attention to its dilapidated condition.

One hundred thousand dollars is a large sum of money, and it may be that everything was not bought at lowest possible prices. It will, nevertheless, be satisfying to the public to know that the efficiency of the quarantine can no longer be suspected. That was the unanimous verdict of the American specialists who visited it.

Grosse Isle is some forty miles from Quebec. The river is so wide at that point that the ocean steamers pass more than two miles from the island. They are met in mid-channel by the *Challenger*, a small tugboat attached to the station, and if there has been any case of infectious disease on board, the passengers and baggage are

taken ashore. A pier is now contemplated to allow the steamers to land their passengers directly.

On landing the passengers are sent to the various buildings provided for them. There is a new and very comfortable building for first class passengers, another for intermediate passengers and six sheds for immigrants. From the top of the saloon passengers' quarters a magificent view of the surrounding islands, the river, the mountain, is to be had. As the bedding, cooking utensils, etc., can be brought from the ship, there are no other hardships attached to detach than the loss of time.

The bunks in all the buildings are of galvanized iron and easily dismounted. There are also an adequate number of compartments where the body is disinfected by shower baths.

The personal baggage of the passengers, such as fur and leather, which cannot support steam heat, is disinfected with bichloride of mercury.

All the other baggage is packed into wire trunks. There is one for each passenger, who is given a check for his baggage. These trunks are then carried into solid iron chambers, which are closed with jacketed doors and steam is turned on.

By a clever automatic arrangement the engineer receives notice of the degree of heat inside of the bundles under process of disinfection and the variations of the thermometer are also automatically registered on a dial, which is preserved as a record. After the baggage has been subjected to a heat varying from 212 to 239 degrees for half an hour the steam is pumped out, and the goods are taken out from the other end of the chamber absolutely dry.

Each traveller receives a check attesting that his baggage has been duly disinfected, and he is ready to proceed with his journey.

On the return trip an informal meeting was held in the forward cabin of the steamer, and cordial speeches of recognition of the efficiency of the present management of the quarantine were made by many distinguished sanitarians from the United States and Mexico.

It was the unanimous opinion of all that the Dominion of Canada had not made any mistake in her expenditure of money to protect herself and the United States from contagious and infectious disease.

The St. Lawrence river is a great thoroughfare for traffic and passengers to Canada and the United States, and therefore sanitary

and other authorities are naturally critical of the existing conditions and were very glad of this opportunity to examine the quarantine, and to testify that its present condition was in accordance with the progress of sanitation, and equal in all respects to that of other places of the same importance.

The quarantine officer, Dr. Montizambert, showed us every attention, and he is entitled to great credit for the vast improvement made during the past two years.

At the morning session Friday the following officers were elected:

President.—William Bailey, M. D., Louisville, Ky.

Vice Presidents.—Granville P. Conn, M. D., Concord, N. H.; Gregorio Mendizabal, M. D., Orizaba, Vera Cruz, Mexico.

Secretary.—Irving A. Watson, M. D., Concord, N. H.

Treasurer.—Henry D. Holton, M. D., Brattleboro, Vt.

There were also three members of the executive committee elected, and it was unanimously voted to hold the annual meeting for 1895 in the city of Denver, Colorado, the date to be fixed by the executive committee.

REPORT OF THE COMMITTEE ON CAR SANITATION.[1]

BY G. P. CONN, M. D., CHAIRMAN, CONCORD, N. H.

A report upon this subject must include several topics, for in order to bring before the public a full realization of its importance, we must consider the construction, the heating, lighting, and ventilation of coaches, as well as the methods of car cleaning now in use by the managements of most roads.

This last is most essential, as it is the first principle of sanitation, without which nothing like a healthy standard can be assumed.

The problem of car sanitation is one of complex character, and involves so many mechanical questions that one can hardly be expected to bring out in a single paper. I have endeavored to get the opinions on this subject from other members of the committee, but have not succeeded in doing so, as for various reasons the different members have begged to be excused, therefore I have selected from the opinions of sanitarians and practical mechanics such quotations as seemed to have a concise, practical, and unbiased bearing upon the conditions necessary to secure sanitation of passenger coaches.

In the design of a car for the transportation of people it is important that it be constructed with a view to stability, safety, and endurance. It must be constructed with a strength equal to the strain which is expected of it, in order that it may be safe to passenger and employé. This is important, for without strength and capacity for endurance, it would be a veritable trap to every one having anything to do with it. It is virtually and for the time being a house on wheels, in which the varying number of people

[1]Presented at the Montreal meeting of the American Public Health Association.

are expected to make their homes for a longer or shorter period, according to the distance which they may be expected to travel. Therefore, like a house it should be constructed upon sanitary principles, in which ventilation, heating, and such conditions as will allow it to be kept clean, are paramount factors in every case. Unless these sanitary principles can be carried out and are made permanent, then this house on wheels becomes unwholesome and unhealthy, and the conditions become favorable to disease or of disseminating it, should a contagious or infectious malady find a place within its walls. Theoretically speaking, a room or a car into which a large number of people are to assemble should have left out of its construction everything that is calculated to foster or develop disease germs, therefore the plainer it can be made, the less upholstery, carpets, and curtains that are placed within, would seem to be the best calculated for health. Practically, however, the public demand something more than plain walls and plain seats, and forget the conditions necessary for sanitation in their desire for luxury. This is an unfortunate circumstance, but it is necessary to deal with the problem as it exists. Probably cars could be constructed with much less expense on leaving out much of the draperies, etc., that are now considered necessary; but as the public demands the luxurious apartments which we find in all well appointed cars to-day, we shall be obliged to consider the different classes of coaches just as they now exist on most of our long lines of travel.

Referring to ventilation it is now twenty years since the state board of health of Massachusetts instituted an investigation into the condition of passenger coaches. They found that the atmosphere of the ordinary coach contained from one to six times as much carbonic acid gas as other public assembly rooms, such as churches, theatres, and public halls. The same year, 1874, at the meeting of the Master Mechanics' Association, the master mechanic of the Boston & Albany, and also of the Old Colony railroad made a report on that subject. It was taken up by the association, and considerable discussion followed. Some improvements came from this action, but since that period the progress of ventilation in cars has not been rapid; in fact, it can scarcely be said that any improvements have been made. Recently, state legislation has placed the obligation upon the management of railroads to use steam heat,

therefore the necessity of further improvements in ventilation has become apparent to every one. In ordinary weather during the winter, the problem of how to heat the car with steam and not have it too warm, is far more difficult in solution than it is to prevent it from becoming too cold. These difficulties are largely due to the fact that the men who have charge of this work are incompetent to carry out the designs of the inventor of steam heat. They have little or no conception of what constitutes good atmosphere in a coach, and they care but little about their work except that the time goes on and they draw their pay. They have no instructor beyond the mechanic who simply shows them how to turn valves which admit the heat, and to shut it off, and the whole problem, as far as they are concerned, is how to keep heat enough in the car to keep it warm. The changing of the atmosphere of the car is of but little moment to them; they are constantly going in and out of the car at every station, and perhaps may be pardoned for not noticing the atmospheric condition that obtains throughout the train.

Another fact in car sanitation, and to me perhaps the principal one, as it involves every principle of sanitation, is absolute cleanliness. This may be impossible in coaches, yet a near approach to it need not be considered impracticable.

Cleanliness is the first principle in sanitation whether it be of cars or houses, and seems like a very simple matter. But when we consider that it involves in its principles cleanliness of atmosphere as well as material, then the problem becomes greater, for in keeping the atmosphere of the car clean as well as its floors and ceilings, you have arrived at what may be called true sanitation. The problem of keeping a car clean is greatly enhanced by the fact that very many good people allow themselves and their children, when riding upon the trains, to become slovenly in their actions, throwing things upon the floor of the car that never would be permitted in an ordinary dwelling house. Why it is that people are so forgetful of good sense and good manners, when riding upon trains, is past comprehension; yet we see it every day, and the coaches become excessively filthy from that cause alone. It may not be easy to break up such habits, yet, if the trainmen formed habits of cleanliness in regard to the coaches which are under their care, it would have a very beneficial effect on the passengers. In the Pullman and Wagner coaches, where porters are employed to wait upon

passengers and keep the car clean, when the occupants so far forget themselves as to cover the floor or carpet with the refuse of orange, banana, or apples, nut-shells, and other things which render a car unwholesome or unclean, and the porter goes around with his dust-pan and brush cleaning it up, it does not take a great many miles of travel for such people to see the error of their ways and to discontinue them. The same might be true of the ordinary coaches if the brakeman or person in charge should perform the same acts, for people naturally would become ashamed of throwing things upon the floor for another person to clean up in order to render the apartment comfortable.

Little need be said in regard to heating of cars, as that has become a question of legal importance. The accidents by fire became so numerous that the different state legislatures took it in hand, passed laws doing away with the ordinary stove and substituting steam heat. Unfortunately there was no concert of action with different roads in the use of steam heat, as each road experimented for itself, the consequence being many different methods of transmitting steam through the cars. Which of these is the best I am not able to state, but it is to be hoped that some uniform method will be adopted by which all roads will be able to effect interchange of cars, and that the instructions which trainmen should receive upon that particular subject shall be so uniform that there will be no difficulty experienced in keeping cars properly warmed and well ventilated.

To digress a moment, I would add that it has been found necessary to open schools of instruction in the use of the air-brake, and I am told that old and experienced trainmen after attending these schools have been surprised to find how little they knew of the practical application of what was supposed to be merely an automatic machine.

Now this instruction is secured by fitting up a car with all the mechanism of the automatic brake, and having a thorough mechanic for a teacher, and why not combine with that the teaching of car sanitation to the extent that the trainmen may fully understand how to use such devices as are now to be found on most passenger coaches.

In regard to the different systems of ventilation several experimenters and inventors have gotten up systems of their own, had

them patented, and endeavored to put them upon the market. Some of them are very complex and all of them require some knowledge of the subject or they cannot be made useful. All of them involve extra expense in the construction of a car.

The question of how to ventilate a car is one which the mechanic and the sanitarian must bring out together. It seems as though it would be quite impossible to invent any system that will change the air of a car while in motion, and at the same time be effective while it is standing still. With electrical power it may be possible to place fans in a car, the same as you do in a house, that will be effective when the car is standing still, but when the car is moving, the pressure of the atmosphere upon the outside is so great that considerable change will take place inside the car. Then again, this pressure of the atmosphere is so much different when the car is moving slowly than it is if the car is moving rapidly, that it brings up another point in the problem of ventilation to be solved by the practical mechanic.

Before the use of the power brake, the duties of the trainmen were almost constant and imperative, but with the advent of the automatic brake his duties were made much lighter and less exacting.

It is true that with the introduction of the various improvements that have been or may be instituted, a higher order of intelligence may be required than was necessary to assist in stopping or starting a train, yet that does not prevent the average trainman from doing good work, provided he has proper instruction.

The *Railroad Car Journal* publishes the report of the committee of the Master Car Builders' Association, from which I quote at length:

"In all modern systems of ventilation, sanitary engineers endeavor to have a plenum instead of a vacuum, or, in other words, to have a slight excess pressure inside of the building instead of a slight vacuum. With a plenum there can never be any cold drafts or admission of smoke, dust, or cinders, for the reason that the pressure would always be driving the air outward through every crack and opening. With a vacuum the reverse is the case, and dust, smoke, and cold air will find their way in at every crack. It is very desirable that the windows of passenger cars be so arranged that they can be locked fast in winter time; to prevent

one obstinate passenger interfering with the comfort of the whole carload, but this can only be done when a sufficient supply of fresh air is constantly being furnished to the passengers, comfortably warmed. The opening of the doors at stations is also a great interference with a uniform system of ventilation. This cannot be avoided, but the evil effects of it can be largely overcome by building the cars with an inner swinging door. Most of the modern, larger passenger cars having smoking rooms, double saloons, and heating apartments, can be very easily fitted up with a swinging door at the end of the passage in between these compartments, which will act as a kind of air lock and prevent a good deal of discomfort otherwise unavoidable. A convenient way of arranging the windows, so as to avoid the drafts and interference to the comfort of the passengers in the winter time, would be to have the outer sash arranged, as is commonly the case now, with the inner sash arranged so that when lowered they will lock themselves tight and can only be released by a lever at the end of the car, attached to a locking bar running the full length of the car on either side. These windows could be kept raised in summer time, the outer sashes being so that the passengers can raise them or lower them as they please. In the winter time, when these sashes are lowered no windows could be raised.

"To summarize, the ideal conditions would be as follows:

"1. The admission of thirty cubic feet per minute per passenger, of fresh air, and the carrying off of an equal amount of foul air, summer or winter.

"2. The fresh air so admitted must not be moving at a speed of more than three or four miles per hour in winter time.

"3. Fresh air admitted must be of a temperature in winter time of about seventy degrees Fahrenheit.

"4. Fresh air so admitted in winter time must have added to it a proper degree of moisture for the temperature at which it is admitted, according to the average humidity of the atmosphere, when at seventy degrees in the climate in which the cars are running.

"5. No system of winter ventilation can be successful unless means for the fresh air supply are provided independently of and separately from the windows and doors, as well as ventilators for carrying off the foul air.

"6. The fresh warm air should be distributed through as many openings and as low down as it can be conveniently arranged for, and the foul air should be carried off through as many small openings in the roof of the car as can conveniently be arranged for in winter.

"7. The ventilation should be entirely independent of the speed of the train, and act equally as well whether the car is standing or running.

"8. The ventilation should be so arranged that there will be a plenum or slight excess of pressure inside the car, so that all drafts will be outward instead of inward, and smoke and dust thus excluded.

"9. It is most desirable that double windows should be used, and so arranged that they can be locked fast in winter time, but readily opened in summer time.

"10. It is most desirable that an inside swinging door be used, so as to form an air lock or inside vestibule, to prevent the admission of cold air and dust every time the doors to the platforms are opened."

In arriving at these conclusions this committee had an investigation made under the supervision of an expert, and incorporated into their report something of his work, and the reasons for summarizing such ideal conditions as they have deemed necessary for perfect ventilation.

The committee add the following:

" It may be argued that there is no use for any such system of ventilation as this, that the present arrangements for the ventilation of passenger cars are good enough, and that nobody is any the worse for the present state of affairs. To show that this is an entirely wrong position to take, your committee had a number of tests made to show the degree of foulness of the air in sleeping cars, chair cars, and the day coaches, which tests have been made under the supervision of Mr. Wm. Forsyth, of the C., B. & Q., through the kindness of Mr. Rhodes. Pure air contains from three to four parts in ten thousand of carbonic acid, and at seventy degrees Fahrenheit an average condition of moisture would be from four or five grains of water per cubic foot.

" Dr. Angus Smith made a series of careful experiments in lead-lined, air-tight rooms for the purpose of seeing how long healthy peo-

ple could exist in an atmosphere having an excess of carbonic acid and moisture. As a result of his experiments, it was shown that it was very unwholesome to breathe an atmosphere having more than seven parts in ten thousand of carbonic acid, and that an atmosphere containing ten parts in ten thousand could not be endured by delicate people for long without injury, and that as the presence of an excess of carbonic acid is a direct indication of the presence of micro-organisms, commonly called disease germs, the injurious effects are not merely limited to the poisonous influence of carbonic acid, but that the danger of taking organic diseases was very largely increased. It was further shown that the senses are a very unreliable guide in judging of the foulness of the atmosphere, and that people who remain in a room in which the atmosphere had become gradually fouled would hardly notice its foulness, whereas outsiders suddenly coming in would be almost suffocated.

" Micro-organisms, or disease germs, are not given off to any harmful extent in the exhalations of healthy human beings, but they are given off in large numbers in the breath and spittle and evaporation from the skin of unhealthy persons. Especially is this the case with people suffering from tuberculosis, whooping cough, fevers, and so on ; and the disease germs grow and multiply very rapidly in a foul, moist atmosphere." To quote a prominent naval surgeon : ' The road is short, straight, and sure, from vomica and mucous patch to the receptive nidus in another's body. Who that has ever had forced on him an aerial feast of cabbage, onions, garlic, alcohol, tobacco, and gastric effluvia of an old debauch, can doubt that aqueous vapor can transport microscopic germs by the same route ? '"

A. L. Gihon, M. D. Address before the Pan-American Medical Congress, Washington, D. C., 1892 :

" Experiments made in Europe on animals which were inoculated with a preparation from the dust beaten out of the cushions of railroad cars in ordinary service, and which cars were not known to have carried sick people, showed that the most of these animals which were inoculated died of violent diseases. Few of them lived long enough to die of tuberculosis—none of them survived. As these micro-organisms are in the air and simply settle on the dust, it goes to show how very necessary indeed it is to carry off the foul air, and that, to quote a southern physician, ' The movement of vast masses of people annually from one section of this broad country

in search of those climatic influences modifying the course and progress of disease has become, from a sanitarian's standpoint, a great unsolved problem, namely, that of accomplishing the proper ventilation of cars by the introduction of pure air, free from dust, cinders, smoke, and so on, and at the same time the withdrawal of the impure air arising from the natural emanations of the body, as well as the more serious dangers accruing from chronic or contagious influences.

"All these devices which depend upon the speed of the train for their action, and where the air intakes surround the stovepipe, every time the car stops the ventilating process ceases and may be reversed; at slow speed it will be almost inoperative.

"Great improvement could, however, be made in the condition of the air in our crowded passenger cars if the trainmen were compelled to pay proper attention to the ventilators; a regular set of instructions should be furnished for their guidance, and division officers should be instructed to pass through the train at every opportunity and report cases where the ventilators have been neglected and the air overheated or foul, to the division superintendent for discipline. The men would then soon learn to attend to this part of their duty. Sleeping-car companies should have a code of rules printed and posted in the cars, and their porters and conductors should be made to observe such rules. One specially important thing is not to open the ventilators on the windward side of the train, otherwise, with drop-sash or trailing-sash ventilators, down drafts and cross drafts are unavoidable.

"The above extract from the report of the committee of the Master Car-Builders' Association, has much to commend it to our notice, as it comes from the best and most advanced class of practical mechanics. As a rule such men are not visionary, but reason from cause and effect, therefore their opinions are entitled to our consideration. I understand the report was written by Master Mechanic Sanderson, of the Norfolk & Western Railroad, of Virginia; yet when asked his personal opinion of its being practical to carry out such ideas, and use the average trainman to accomplish the work, remarks in rather a sarcastic manner,—'I wonder what the A. R. U. or any other railroad organization would say if we require our immaculate brakeman to do the chores in the railroad cars.'"[1]

[1] Mr. Sanderson, Master Mechanic of the N. & W. R. R., Roanoke, Virginia.

Another member of this committee, when asked if he believed it was possible to carry out such an ideal system as the report would allow the public to expect would be in use in a few years, says,— "I would say in answer to your first question, that I do not believe, as a railroad mechanic, that it will be possible to introduce and have accepted by railroad managers, the ideal conditions in a passenger car as expressed in the paper that was read on this subject. I do believe that if our trainmen were educated to make better use of our present facilities there would be less complaint. They have been relieved from year to year of their former duties, until they feel that all they need to do is to wear a uniform." [1]

Undoubtedly this is true, and we are all the more ready to believe its truth after having once asked one of these uniformed "Mikados" to ventilate the coach. That look of pity and condescension makes an impression never to be forgotten.

In support of that part of the report which I have quoted—relating to experiment on animals inoculated with a preparation of dust from passenger coaches—I will give an extract from the report of scientists who have recently concluded a series of experiments, under the direction of the Imperial Board of Health of Germany, as to the danger arising from the dust in railroad carriages. Their results show a decided risk involved in travelling under the present sanitary condition of the coaches.

"The dust was collected in each instance from a square metre of surface, and from forty-five compartments, representing twenty-one carriages. The inoculations were made upon guinea pigs. Many of them died of various diseases, and the rest were killed. Three only were found to have tuberculosis. The number of bacteria was largest in the fourth-class cars, and grew less with each rise in grade of the compartments. In the fourth-class cars the number was estimated at 12,624 per metre; in the third class, 5,481; in the second, 4,247; and in the first class, 2,583. On the seats and upper walls the numbers varied in the four classes from 2,646 to 29, while the roof was almost free. Though the third and fourth class carriages were the most infected, it was much easier to clean them, as they could be washed with hot water and soap, which could not be so vigorously applied to the better class carriages owing to the carpetings and upholstery." [2]

[1] Mr. West, Master Mechanic, N. Y., O. & W. R. R., Middletown, New York.
[2] Boston Medical and Surgical Journal.

The following letter, written on a trip to the Eastern states, says: "In our sleeper were three consumptives returning home to die, and that alone was depressing enough, but when, on getting up in the morning, one sees a considerable amount of dry, yellow sputum on one's vis-a-vis neighbor's bed linen, it is neither dainty nor reassuring. Morning cogitations, usually so pleasant, are apt to turn to the uncomfortable possibility of all the bedding in the car being subjected from time to time to the same infection, and being probably imperfectly washed or simply rinsed. Then it is impossible to clean the upholstering and carpeting without taking them out of the car, and an infected sleeper should be dangerous as the continual vibration keeps the dust and bacteria in the air. The space is also necessarily confined. Moreover, travellers are apt to catch cold from drafts and from sleeping close to the windows, thereby rendering the mucous membranes receptive to germ implantation.

"They order these things better in Europe; on some of the continental lines special coaches are provided for consumptives, and these are constructed with particular reference to ready cleansing and disinfection at the end of every trip, which, it should be noted, are much shorter than the 'runs' in this country, and the need of precautions is, therefore, and for so much, greater here than abroad." [1]

Dr. S. S. Herrick of San Francisco read a paper before the section on state medicine, at the meeting of the American Medical Association the present year, entitled, "Common Carriers as Disseminators of Contagion."

The writer dwelt particularly on the disposal of excretion in the people on inland waters and on railway coaches; believing that certain communicable diseases whose contagious properties are discharged from the alimentary canal are liable to reach the alimentary or respiratory tract of other persons if not intercepted or destroyed, and cholera, or typhoid fever, dysentery, intestinal tuberculosis, and other filth diseases are notably transmitted in this way.

He says: "Companies who provide meagre accommodation for passengers were properly censured, and should be held justly responsible if inadequate remedies were provided for their patrons."

Discussion by Drs. Ruggles and Cochran, Davisson and Stoner, all of whom were in accord with the opinions advanced by Dr. Herrick.

[1] Dr. Douglass W. Montgomery's letter to the Pacific Medical Journal.

These men, while enthusiastic supporters of preventive medicine, are gentlemen of sound judgment and are not carried away by any desire for notoriety. They believe the state and federal authorities should be ever on the alert to secure health for the individual, and that it is a duty which they owe to the people of the country to have a watchful care over the transportation company as well as the municipal lines governing health officers.

The *Ohio Medical Journal* says of the prevention of consumption:

"We do not deem it wise or prudent to invade the homes of tuberculous patients for the purpose of securing disinfection or the isolation of the sufferer. The instruction of the patient and his household by the physician, in the necessity of prophylactic measures, is at present sufficient; but we believe that a vast deal of good might be done by the exercise of strict sanitary measures against the contamination of rooms in hospitals and hotels, and the berths in sleeping cars. The most careful cleansing and disinfection of apartments occupied by consumptives should be required before other individuals are permitted to occupy them."

As we have said before in this report, cleanliness is one of the first principles of sanitation; whether it be a car, a house, an office, or a work-shop, the same principle holds good. In the construction of coaches for passenger use, something should be done to render the cleaning of the car a matter of small expense, for while in process of construction little things might be done that would add to their convenience, healthfulness, and cleanliness.

All passenger cars at the present time are constructed with water closets. The floor of such closets and a few inches of the side or mopboard should be covered with sheet copper, as an ordinary wooden floor will soon become filthy and can never be made clean. Odors will always be given off from an ordinary board floor whenever the temperature rises to that of summer heat; but if the floor be covered with sheet copper, hot water, dry steam, and chemicals may be used, leaving it without any absorbing surface to develop odors which may be latent in cold weather and very active on a hot summer day. If the designer and purchasing agent give attention to this in the first instance, the extra expense will be little or nothing, and will add very much to the efficiency of the car when the rules of sanitation are applied. As cars are now heated with steam direct from the engine, and as these pipes pass through water closets

for the purpose of protecting them against the cold weather, I can see no reason why taps may not be placed in those pipes in water closets and used for the purpose of cleaning them with hot steam; and it certainly could be but very little extra expense at the time of the construction of the car.

Dr. S. S. Herrick of San Francisco, Cal., in commenting upon a statute law of that state relating to maintenance or commitment of a nuisance, remarks:

"Obviously travellers should not be held responsible for committing a nuisance, so long as transportation companies provide no facilities for obviating the same; and legislation should be aimed directly at these companies, holding them responsible and requiring them to provide an adequate remedy.

"It is well understood that the law must not ordain what is impracticable, and equally plain that no serious difficulty and expense would be involved in abating such nuisances. No mechanical difficulty exists for a steamboat or railway coach to have its closet provided with a closed receptacle, having suitable means for deodorizing, disinfecting, and ventilating, and for discharging the contents into some proper place at short intervals. The details of a contrivance suited to such a purpose need not here be entered into. They belong to the inventor and mechanic, rather than to the sanitarian as such.

"Aside from considerations of health, it seems strange that respect for common decency has not abolished a practice in travel by land which would have brought a blush to common carriers in the good old days of slow coaches. While inventors and builders of palace cars are doing so much for the comfort and convenience of passengers in other respects, they adhere to a form of closet from which travellers must be excluded at the time when it would be most acceptable (halting at large stations) and which scatters filth and disease along the route. It is to be noted that cholera still lingers in Europe, and meanwhile we must not consider ourselves safe here within two weeks' travel by steam; while the other filth diseases, like the poor, are always with us.

"In my judgment the time has come for sanitarians to speak plainly and forcibly on the subject, and to demand of legislators a specific remedy which courts will be bound to apply to this class of offenses against health."

I understand several roads are making use of compressed air for the purpose of cleaning the draperies and plush covering of the seats, and that a plant for that purpose can be arranged to be effective with small expense. If this is true, and I see no reason why it is not, it should be generally used, for thorough cleaning with fresh air would be a most valuable disinfectant.

The vestibule train has become very popular, and no one doubts its efficiency as an easy riding coach, and insures perfect safety in going from car to car; but as an object lesson for the ventilation of cars it becomes a failure, inasmuch as it simply ventilates from one car to the other. Of course some air will pass into the vestibule section, but as that section has less width than the car itself, the pressure of the atmosphere extending to the car is much lessened than what it is upon the sides of the car itself, therefore but little air is forced in from that section of the construction, as the ventilating property of the vestibule is lost, and aside from that it may be overcome by the extra heat of lighting.

This leads one to consider the lighting of cars. Nearly every large road has been experimenting with the different methods of lighting coaches, and car companies like the Pullman and Wagner have done the same. Whether these experiments have been conducted in the light of sanitation, or as a question of expense, may be a matter of doubt, although it is probable that the safety of the car from destruction by fire has entered into the range of experiments. Gas and kerosene lighting while moderately expensive are not only dangerous by reason of their possibility of fire, but the extra heat which they occasion in the car in the summer time, proves a very serious obstacle to the comfort of the passengers. Then again, the destruction of oxygen by gas or kerosene lighting increases the amount of carbon dioxide in the atmosphere of the car, oftentimes to a dangerous extent, and in that way the health of the passengers is seriously threatened unless there is a large amount of fresh air introduced continuously.

That electric lighting is the ideal of the present time perhaps no one will dispute, unless the expense of the same is taken into account. So far as I can learn none of the devices for electric lighting have yet been brought down to the maximum of the manager's idea of expense, and therefore some other method will find favor until the public demand safety in lighting as well as in heating coaches.

It would not seem that it would be necessary in a report like this to make any allusions to the water supply of railway coaches, but the Medical Society of New York has adopted a report calling attention to the danger of drinking water from the average water-tank, as found in railway cars and other public places. Many cases of typhoid fever of mysterious origin, it is said, could be traced to the filthy water-tank, which has been filled with water and ice of doubtful purity, and re-filled from day to day without cleansing. Nevertheless, people must have something to drink in hot weather.

From this we may learn that the public are critical regarding the water supply. Some years since, Dr. Reed of Ohio, in investigating this matter, found that the water-tanks of ordinary coaches, and sometimes those of palace cars, were notoriously filthy. The water supply must of necessity depend largely on the character of the supply at given points along the line. When cars are cleansed and the water-tanks refilled, the ice supply depends upon the same conditions, but there can be no excuse for filthy tanks any more than in public or private houses. There are enough men employed about the trains to see that every tank is made clean day by day, and not to do so, and thereby endanger the health of the traveling public, becomes criminal.

In conclusion I have but little to add, as until the use of such devices for lighting, heating, and ventilating as we now have are fully understood and appreciated by the average trainman, who should be held responsible to his superior for the safe condition of his coach from a hygienic as well as a mechanical point of view, it is useless to assume that a more elaborate mechanism will find favor.

Nothing as yet approaching an automatic system in heating, lighting, or ventilating a car has been placed before the public, but as it is only a comparatively short period since automatic brakes and couplers have been placed upon the market, we may confidently look forward to the time when the public demand for hygienic improvements will evolve from the mind of man some plan or system to meet the emergencies of the occasion.

In order to do this effectually some one connected with the road would have to instruct the employé in the use of hygienic appliances, the same as is now necessary in the use of automatic brakes; and it would seem quite practical that all roads having a surgical department, should extend this work into the domain of hygiene, and

give the surgeon in chief authority to inspect, instruct, and to hold responsible such employés as are in any way concerned in maintaining a healthy condition of our trains. The surgeon more than any other person connected with railroads appreciates the hygienic condition of coach, stations, and grounds of our railroads, for in case of accident, he has much to contend with that is unknown to the physician and surgeon called to see those injured in ordinary accidents, and therefore will always be on the alert for all sanitary improvement.

However it may be brought about, the employé should be taught how to make the best use of all the devices in use to promote the sanitation of cars; and should be held responsible for any unsanitary conditions arising by reason of his negligence.

THE MILK SUPPLY OF A CITY.

In The Light of Modern Bacteriological Research.[1]

BY JOHN H. KELLOGG, M. D., BATTLE CREEK, MICH.

The milk supply of a city is, from a sanitary or public-health standpoint, a matter of the highest importance. In fact, of the many questions which come before the health officer or the sanitarian for consideration and study, none are of greater importance than those which pertain to the milk-supply, with the exception of those relating to air and water supply. I think the truth of this statement will not be questioned when it is remembered:

1. That milk in some form, as milk, butter, or cheese, is almost universally employed as an article of food among civilized people; and

2. That modern bacteriological study has shown that milk is one of the most common and efficient means by which disease germs may be communicated to the human body.

A number of common and very fatal maladies have been traced to the use of impure milk. Omitting maladies concerning which authorities are still somewhat in doubt, the following may be mentioned as those concerning which the fact of the communication by milk is well established: Typhoid fever, cholera infantum, and tuberculosis, or tubercular consumption—three of the most deadly diseases known. It is very probable, also, that diphtheria, scarlet fever, and several other maladies are communicated through the medium of milk.

But if no other maladies than the first three named are liable to

[1] Presented at a Sanitary Convention in Michigan, October, 1894.

be disseminated by the use of milk, there is ample reason for regarding this article of food with grave suspicion until its purity and innocuousness have been established.

An important reason for the consideration of this matter at the present time is the fact that within the last few years the developments of the science of bacteriology have rendered it necessary for us to carefully review and remodel many of the practices of modern life, and to attach great importance to matters which were formerly very lightly regarded.

The customs and environments into which we were born are those which were modeled upon a state of knowledge which did not include more than the smallest degree of enlightenment in relation to the germ causes of disease. The present knowledge concerning this subject is almost wholly the product of the scientific labors of the last quarter of a century, and a much shorter time has elapsed since the intensely practical value of a great number of long-known facts has been fully appreciated, even by students of science, and it now becomes the duty of sanitarians to bring these truths of practical importance, which have a most momentous bearing upon the conditions and customs of every-day life, home to the people in such a manner as to command their attention, and secure for the scientific facts presented a practical recognition.

Some twenty years ago the writer was exhibiting, through a microscope, to a lady of more than ordinary intelligence, some of the forms of microscopic life which occasionally infect food substances. When she learned that notwithstanding their formidable appearance through the microscope, their actual size was measured only in thousandths of an inch, she exclaimed with great emphasis, "I am not afraid of such little fellows as those are!" Unfortunately, size is not a measure of capacity for mischief. The farmer dreads much more the minute weevil or the microscopic smut which attacks the grain in his wheat fields, than the mole which burrows about its roots.

The eminent French scientist, Pasteur, has shown the very great power for mischief which resides in the infinitely small. Microscopic forms of life, animal and vegetable, are vastly more potent for mischief in this world, more destructive to human life, than any of the more obvious and better known causes of death and disease.

The accompanying illustrations show some of the more common

and interesting forms of microbes, representing, however, only a very few out of the many thousands of forms which have been studied.

Numerous observations during the last twenty-five years have shown that milk is a frequent means of communicating typhoid fever infection. Infection of milk has sometimes been traced to the adulteration of the milk with water which had been contaminated by excreta from typhoid-fever patients. In other cases the infection has occurred through the washing or rinsing of the milk cans or pails with infected water. There is, however, another source of infection which has been generally overlooked.

Several years ago when I was a member of the state board of health, at one of the quarterly meetings of the board I called attention to the possibility of the infection of milk with typhoid-fever germs through the excreta of cows; and in a paper read in 1888, before the Calhoun County Medical Society, upon the "Propagation of Typhoid Fever," I also called attention to this means of infection, which I believe to be one of the most common, although as yet rarely recognized. It is very well known that in a great number of cases of typhoid fever it is impossible to trace a direct relation to a preceding case. I believe that in a large proportion of these cases a thorough bacteriological study of the milk-supply would show this to be the source of infection.

It is generally held that cows are not subject to typhoid fever; nevertheless it is entirely probable that the capacious colon of the cow may serve as an excellent field for the development of typhoid-fever germs. While the digestive fluids of the stomach of a cow, as well as the gastric juice of the human stomach, are capable of destroying typhoid-fever germs under certain conditions, it is doubtless true in the case of a cow, as with human beings, that derangement of the digestive organs may so alter the character of the digestive fluids as to deprive them of their power to protect the body from the invasion of germs by digesting these destructive organisms. In other words, a cow which might not be able to transmit typhoid-fever germs while in a state of health, might while suffering from indigestion as the result of excessive feeding or the use of improper food, if infected, transmit through her alimentary canal the germs or their spores without destruction, thus infecting the milk.

The importance of this subject is at once recognized when we consider the facility with which the fecal matters of the cow become mixed with milk especially when cows are kept confined in a stable or small enclosure.

A few years ago, I attempted to settle this question by actual experiment. A calf was regularly fed, first with sterilized milk inoculated with a pure culture of Eberth's typhoid bacillus and later with sterilized milk inoculated with fecal matters from a typhoid fever patient. The fecal matters of the calf were regularly collected and sent to Professor Novy, of the University of Michigan, for bacteriological examination. The conclusions reached were not as definite as could be desired, but among the various bacteria isolated, Professor Novy found a number which resembled very closely the typhoid bacillus, and some which were apparently identical with the bacteria which Professor Vaughan has associated with typhoid fever. The experiment, while it did not actually prove that Eberth's bacillus may pass unchanged through the alimentary canal of the cow, did show that the fecal matters of a calf fed upon milk infected by the excreta of a typhoid fever patient, contain fever producing germs.

Recent bacteriological studies of the cause of typhoid fever have developed another fact which is of great practical interest in this connection.

Rodet and Roux, two eminent French investigators, as the result of extended investigations, have arrived at the conclusion that the so-called bacillus of Eberth is at least not the only cause of typhoid fever, but that in many cases the disease is due to another germ, the bacillus coli, a microbe which is constantly present in the colon of all mammals.

The author contributed a paper upon this subject to the proceedings of the American Public Health Association, at its annual meeting held at Mexico City, 1892, in which the facts bearing upon the question were presented at length. Among these facts may be mentioned the following:

1. The bacillus coli, found in the excreta of man and of all domestic animals, is capable of producing disease apparently identical with typhoid fever, and various forms of intestinal disease, as cholera morbus and cholerine.

2. The colon bacillus develops virulent properties outside the

body when deposited in vaults, in which it may live a long time; while Eberth's bacillus, the so-called bacillus of typhoid fever, quickly dies when exposed to the ordinary conditions found in vaults.

3. The colon bacillus obtained from excreta which has been deposited in vaults, produces toxines of much more deadly character than those of the bacillus obtained directly from the colon and those produced by Eberth's bacillus.

The immense importance of these facts will be recognized only when we take into consideration the facility with which cows may become infected with the excreta of human beings. Although no small care is taken to secure pure water supply for human beings, very little attention, indeed, is given to the water supply of animals, probably because no serious ill effects can often be traced directly to the use of impure water by animals, at least so far as the animals themselves are concerned, the fact being overlooked that while domestic animals may have acquired a certain immunity from the effects of impure water by constant exposure, they may be the vehicle for transmitting these impurities to human beings. But in the light of the facts presented, is it not clear that the same pains should be taken to provide a milch cow with pure water as is taken to secure a pure water supply for direct consumption by human beings?

It is safe to say that very few people, indeed, are fully acquainted with the dangers to life and health which lurk in the milk supply. Strange as this may appear, a still stranger observation is the fact that almost every savage nation on the face of the globe that makes use of milk in any form, has learned by experience to adopt measures of protection of a more or less effective character, while the English and Americans are about the only peoples who seem to have profited nothing by sad experience in this particular.

Among most savage tribes milk is seldom or never used. The teeming millions of China—a country which contains nearly one third of the entire population of the globe, are practically ignorant of this article of food. The high caste Hindoo regards milk as a loathsome and impure article of food, speaking of it with the greatest contempt as "cow juice," doubtless because of his observations of the deleterious effects of the use of milk in its raw state.

The savages of Central Africa make use of milk only after con-

verting it into a sort of kumyss by leaving it for some hours in a gourd specially prepared for the purpose. A portion of the ferment is always left behind in the gourd, so that a strong degree of acidity is developed in a few hours.

The half-civilized Tartars of Western Asia prepare milk in the same manner, as do also the Turks and the Armenians. The natives of Italy use milk from goats instead of that from cows, a custom which will be better appreciated when the fact is known that goats are not subject to that dread disease, tuberculosis, so common among cows. Even the German peasant scalds the milk as soon as it comes from the cow, and makes little use of the article except in the sour state, in which it is comparatively safe. The Irish peasant is equally fond of sour milk, and the same is true of the natives of Scandinavian countries.

The French dairywoman scalds the cream before she churns it, experience having shown her that by this method a superior quality of butter may be made, although the philosophy of sterilization is probably unknown to her.

American and English people, as before stated, stand almost alone in the recklessness with which they make use of raw milk as a food and as a beverage, and in the fact that they seem to have learned nothing by the experience of centuries in the use of an article which is certainly responsible for a prodigious annual addition to the mortality list.

Let us glance into the conditions which give origin to the microscopic dangers to life and health which lurk in milk.

There are various germs which change the color of milk, each producing a characteristic color. Other germs produce a peculiar flavor, as acid or bitter, still others change the consistency of the milk, producing either a thickened or coagulated condition, or rendering the milk thready or viscid in character. The following are a few of the more important examples of this sort:

Blue Milk.—The peculiar color of blue milk, not referring, of course, to milk which has been made blue by skimming, is due to the development of a peculiar coloring matter by the bacillus cyanogenus. The blue color does not appear, however, when the germ is planted in sterilized milk, but only by its growth in raw milk, as the development of the blue color requires the presence of lactic acid. A gray color is produced in sterilized milk.

Red Milk—The bacillus prodigiosus gives rise to a red color, which appears in patches upon the surface of the milk. Two species of red yeast produce a red or brownish color, which first appears at the surface of the milk, then gradually extends until the whole is colored.

The bacterium lactis erythrogenes colors the whey only.

A dozen different lactic-acid-producing germs are ordinarily found in milk, and there are a great number of other germs which produce sour milk.

Freudenreich has shown that the unusually spongy condition often found in cheese, giving the cheese a swollen or puffy appearance, is frequently due to germs furnished by the intestines of the cow. Some germs ferment casein but do not produce lactic acid, but a sort of rennet. The germs which produce lactic acid are killed at a temperature of 158 degrees F. The spores of some germs which ferment casein resist a temperature above the boiling point of water, sometimes even 248 degrees F.

There are many of these germs, ten or more species of which are well known, besides a large number included under the general term, "potato bacilli," which comprise a great variety of germs that grow upon the surface of the earth, and also a large number of bacilli which cause butyric acid fermentation.

Cheese owes its properties to the development of these various germs at the expense of the sugar of milk, the casein, and the fat which it contains.

Drs. Schaffer and Bondzynski showed many years ago that cheese made from cooked milk does not mature.

Adametz has shown that the addition of thymol and other germicides to milk in making cheese prevents the maturing of the cheese.

Yeast and Molds—A variety of yeasts grow in milk. The characteristic action of yeast in milk is the production of lactic acid and alcohol. Some of these yeasts coagulate milk, others do not. Kumyss is one of the familiar products of the action of yeast upon milk. Kephir is a variety of kumyss produced by a peculiar yeast found in the so-called Kephir grain.

The red yeast already referred to, sometimes develops in cheese.

A white mold, *oidium lactis*, sometimes forms upon the surface of milk as well as upon other substances.

Green mold also sometimes attacks milk. It is, in fact, the prin-

cipal agent in the production of the famous Roquefort cheese. Brie cheese owes its peculiar properties to mold. In the manufacture of these varieties of cheese, the development of mold is promoted for the purpose of securing the peculiar flavors characteristic of these molds when grown in milk.

Yellow Milk—Bacillus synxanthus produces a disease which coagulates the milk, then a rennet which dissolves the casein and colors it yellow.

Bitter Milk—There are many different germs which produce bitterness in milk. They are most likely to occur in milk which has been boiled and then allowed to stand for a long time. In raw milk they are overwhelmed by other germs, and do not develop ; but the spores survive cooking and develop later. There are a few germs capable of causing bitter milk which resist the action of other germs and grow in raw milk.

Thready or Viscid Milk—More than a dozen different germs have been described which produce a thready or viscid condition of the milk. It is a singular fact that this condition of the milk is promoted as the basis of the manufacture of Edam cheese. Conserves of thready milk are also made in Norway, where pains are taken to produce a viscid condition of the milk in the manufacture of a peculiar kind of preserved milk known as Tattemyelk. The condition is produced by adding small leaves of a species of grass, the *pinguicula vulgaris* ; sometimes instead, the same grass is fed to the cows, which suggests at once the manner in which the milk may become infected. The cows eat the grass, the mouth and nose of the cow become infected, they transfer the germs to the udder, and from the udder they readily find their way to the milk pail.

Disease-Producing Germs—Much more important from a sanitary point of view than the various yeasts, molds, and color-producing germs which have just been mentioned, are the pathological microbes, or disease-producing germs, many of which grow with great facility in milk. Some of the diseases arising from these germs, as cholera and typhoid fever, have already been referred to.

It has been shown that cholera germs grow with less facility in raw milk than in cooked milk, lactic acid interfering with the development of the cholera germ, so that sour milk may be, under certain conditions, safer as an article of diet than sweet milk, if the latter is uncooked.

Certain forms of influenza have been proven by Freudenreich, the director of the Bacteriological Laboratory of Berne, Switzerland, to be transmitted by means of milk. This was found to be especially true of the peripneumonia of hogs.

Dr. Hart, an eminent English sanitarian, records fourteen epidemics of scarlet fever and seven of diphtheria, originating in England in which the contagion was disseminated through the medium of milk.

Typhoid fever has been found to originate in the use of infected milk in a great number of cases, as has already been shown. The typhoid fever germs grow with great facility in milk.

One of the greatest of all the dangers connected with the transmission of germs by means of milk, is encountered in the fact that the germs of tuberculosis thrive in milk, and retain their vitality for many weeks even, in butter and cheese. The bacillus tuberculosis, the contagious element of the disease commonly known as consumption, is probably more frequently to be found in milk than any other dangerous germ.

Hirschberger, an eminent German authority, found ten per cent of the cows in the vicinity of large cities affected by tuberculosis. Cows kept for dairy purposes in the immediate vicinity of cities are generally subjected to much more unhealthful conditions than those in the country. The milk of half the cows examined, or five per cent of the entire number, was found to contain the tubercle bacillus. As the milk from the different cows was mixed together, it is probable that nearly the entire milk supply of the cities supplied by the cows examined, was infected with consumption germs.

An investigation of this subject made in Copenhagen a few years ago, showed tubercle bacilli in one seventh of all the specimens of milk examined.

Brouardel, an eminent French authority, found five cases of tuberculosis in a small boarding school of fourteen girls. The disease was traced to the use of the milk of a tuberculous cow.

Gasperini found tubercular germs alive in butter at the end of 120 days.

Gautier found them alive in cheese at the end of thirty-five days.

The importance of this subject can only be appreciated when bearing in mind the extent and increasing prevalence of tuberculosis in human beings.

The fact that in older populations, like those of England and New England, the proportion of deaths from consumption to deaths from all other causes rises as high as twenty or thirty per cent, while in the newer communities of the west the proportion falls to eight or ten per cent., is an evidence that conditions exist in intimate connection with life in a civilized community which favor the development of this dead disease. The revelations of the post-mortem rooms connected with the metropolitan hospitals of this and other countries, have shown that sixty per cent. of hospital patients who die have suffered at some time in their lives from infection by the bacillus tuberculosis, as evidenced by the characteristic lesions which have been left behind. The great majority have, of course, recovered from the disease—thanks to favorable conditions and the natural recuperative powers of the body—but this fact is, nevertheless, evidence that infection of the human race in civilized communities with the bacillus tuberculosis, has come to be, at the present time, exceedingly common. Indeed, it may be said that such infection threatens to become universal.

It is an inevitable conclusion, from these facts, that the causes of tubercular infection, whatever they may be, must be widespread and intimately connected with the conditions of civilized life. That tuberculosis is an infectious malady is a question which we shall not undertake to discuss, as the purpose of this paper is only to bring before this convention this highly important question for the purpose of inviting a discussion of the possible relations which exist between this malady and the use of cow's milk.

That consumption is in some way connected with the cow is thus very able argued by Dr. F. R. Brush, who calls the cow "the wet nurse of consumption :"

" Scrofulous females in the human race usually secrete an abundance of milk, because in scrofula there is an unusual tendency to glandular enlargement and activity. As the mammary is the highest type of glandular structure, it is stimulated to increased action. A scrofulous cow is usually the largest milker, and the closest kind of consanguinity has been practised by cattle breeders, with the object of producing a scrofulous animal, not because she is scrofulous, but because the particular form she represents are the largest yielders of milk. We find, too, that consanguinous breeding has been alleged as one of the causes of tuberculosis in the human race, where it can

never be conducted with so close and intimate blood relations as in the dairy animals.

" The absence of phthisis in high, dry mountainous regions has been accounted for by reason of the altitude and absence of moisture in the atmosphere, but here occurs a somewhat curious fact ; namely, that the cow does not thrive in the high, dry mountainous districts, but on the low, swampy, moist region where the succulent and moist grasses grow, is the place where the cow flourishes, and it is in these regions also that tuberculosis abounds in both bovine and human subjects."

That tuberculosis may be communicated through the milk of tuberculous animals, at least under certain circumstances, is strongly suggested, if not absolutely proven, by the disproportionate frequency with which enteric consumption occurs in young children. A case recently reported in medical journals illustrates very clearly the possibility of infection by tuberculosis through the alimentary canal. Four infants were cared for by a tuberculous nurse who fed the little ones with a spoon, and was in the habit of tasting the milk herself to test its temperature before each feeding. All four of these children suffered and died from enteric consumption—a very clear case of infection.

In a recent paper read before the New York Veterinarian Medical Society, January 9, 1894, published in the *Journal of Comparative Medicine*, Dr. James Law, of Cornell University, states as follows : " In the case of calves sucking phthisical cows, they have done badly and proved unthrifty, though they took the whole of the milk furnished by their respective nurses, and they have thriven better when weaned and put upon solid food alone. I have followed some such calves until they grew up and were slaughtered, and have made post-mortem examinations and found them bearing old calcified tubercles, pointing back to the time when they sucked the infected and poisonous milk."

Bollinger showed that a pure culture of tubercle bacilli gives positive results in inoculation experiments in a dilution of one to four million parts, thus showing that milk may be infectious when the bacilli are so scanty as to be undiscoverable with the microscope without an extremely exhaustive examination. This shows that inoculation is really the only method of determining the infectious or non-infectious character of the milk.

Hirschberger made inoculation experiments on guinea-pigs with samples of milk obtained from twenty tuberculous cows. He obtained positive results in 80 per cent. of his experiments, in cases in which the disease was far advanced, and in 35 per cent. in cases in which the tuberculous process was confined to the lungs. The milk was found to be more infectious at certain times than at other times, the increased infectiousness being due to the presence in the milk of spores which had been set free from some focus of the tuberculous disease and absorbed into the lymph channels, and thus carried to the mammary gland and secreted with the milk. A most painstaking microscopical examination made of the milk, even in the successful cases, failed to reveal the presence of the tubercle bacilli except in a single case, showing the unreliability of this mode of examination.

The following case is cited by Hirschberger as a very convincing illustration of the infectious character of milk from tuberculous animals : " The owner of a very valuable herd of cattle," says the author, " finding that a very large proportion of them were tuberculous,—so large a proportion, indeed, as strongly to suggest infection by association in the sheds—withdrew his milk from the market, and used it, unfortunately without boiling it, for fattening his pigs, of which he has a large number, and on which he prides himself not less than on his cows. The result has been that the pigs have, almost without exception, been affected with the disease to an extent that has necessitated the slaughter of the whole stock."

An important fact which seems to have been overlooked until recently, is that to which Professor Law has called attention in the paper above referred to. Since Professor Koch's famous experiments with tuberculin, which created so profound a sensation in the medical world a few years ago,it has been well known to physicians that the substance known as tuberculin—the toxic product of the tubercle bacilli—is capable of producing most profound effects when introduced into the system of a human being or an animal in the slightest degree affected by tuberculosis. It is the paralyzing influence of this poison upon the tissue elements which gives rise to the necrosis of tissue, and the formation of cavities in the lungs and other organs which are the seat of tubercular deposits.

Having been one of the first in this country to obtain a supply of tuberculin, which I did through the kindness of the American

minister at Berlin, I have had an opportunity to study its effects upon human beings, and, with others, have been greatly astonished to see the profound effects produced by the most minute doses, so small a dose as even the fraction of a milligram—perhaps one five-hundredth of a grain—being capable of producing positive systemic effects. I have known of the injection of two or three minims of tuberculin to give rise to an elevation of two degrees of temperature in a perfectly healthy cow, and have seen a temperature of 105 degrees in a human being—an elevation of six and one half degrees above the normal—result from the use of one or two milligrams of tuberculin. A poison which is thus active in such minute doses must be very potent indeed.

In a tuberculous animal tuberculin is being constantly produced in quantities exactly proportionate to the number of bacilli actively present. The rapid elimination of the poison through the kidneys and other excretory organs saves the patient from profound toxic effects, although the steady wasting of the tissues which has given rise to the significant name of "consumption," the rise of temperature, the night sweats, and the diarrhœa are all evidences of continued toxæmia. When, however, the amount of this extremely powerful poison, which is constantly present in the system, and to which the body accommodates itself to a certain extent, is increased by the hypodermic injection of even a small quantity, the tolerance of the system which had been gradually acquired is overborne, and the toxic effect is manifested in what is termed a reaction. These effects can be easily watched, if the tubercular lesion is superficial, as in lupus, and are manifested in a marked change in color and a swelling up, and finally in death and sloughing of the affected parts. If the affected tissues happen to be upon the surface of the body, or if in the lung, located close to a large air tube, suppuration of the diseased tissues and a complete clearing away by the sloughing may occur, and all of the affecting microbes may be carried away with the sloughing mass. Thus, recovery may result. But if the tubercular foci are not thus favorably situated, but instead are located in the depths of the tissues, as in the centre of some dense organ, then the effect of the tuberculin may be to break down the wall of resistance which nature has thrown up around the tubercular mass, and thus set free the myriads of active microbes which had previously been restricted to a small area, and so set up a gen-

eral infection of the whole body, converting a local and comparatively harmless lesion into a general infection and hopeless disease. It was the possibility of such results as these which led to the abandonment of the use of tuberculin in the treatment of consumption by the great number of enthusiastic physicians, who, like myself, seized eagerly upon the much-praised panacea for the most destructive of all human maladies.

From the above briefly stated facts, it is apparent that the evil results which follow tuberculous infection are not wholly due to the bacillus itself, but are also attributable to the toxines produced by it.

Now, the important fact to which Law has called attention is this,—namely, that even though the milk of a tuberculous animal may be proved to be free from tubercle bacilli, and hence not capable of giving rise to tubercular infection, or if the infected milk shall have been sterilized so that it no longer contains living bacilli, still these animal products are, nevertheless, capable of producing most potent mischief through the toxic products of the bacilli which they contain.

In the blood and lymph of every animal suffering from tuberculosis there must be circulating a variable amount of the extremely toxic substance called tuberculin. The milk, as well as the juices of the flesh, of such animals must always contain a certain proportion of this poison. It is thus apparent that whoever makes use of the flesh or milk of such an animal is thereby introducing into his system more or less of this extremely active and dangerous poison. That the effects of poisoning through this source are not everywhere recognized is no evidence that such effects are not produced. As Professor Law very well says, "It is the scrutiny, and not the facts, that is wanting." We have not been looking for facts from this source, and so have not seen them. But that effects must be produced there seems to be little, if any, room to doubt. Professor Law says,—"In my experience with tuberculous cows, cases have come to my knowledge in which invalids drinking the milk of such animals have suffered very obviously, and have improved after such milk has been withheld." The same fact has been noted by Professor Law in relation to calves, as stated in the quotation previously made.

Dr. A. N. Bell, editor of the *Sanitarian*, a number of years ago

undertook a research in relation to the influence of the milk of tuberculous cows upon infants. He found that a great number of infants supplied with milk from a certain dairy were sickly, puny, and in every way unthrifty. Investigation showed that a large number of the cows in this dairy were tuberculous. This observation agrees entirely with that made by Professor Law. I have made no personal observation of this sort, but a laboratory observation which I made a year ago seems to have sufficient bearing upon this question to be worth relating. In the course of a series of experiments for the purpose of studying, by the method of Bouchard, the relation of the toxicity of urine to various maladies, I made use of the urine furnished by a consumptive patient. The experiment consisted in the injection of carefully filtered and neutralized urine into one of the veins of the ear of a rabbit, which had previously been carefully weighed, its temperature taken, etc. A careful note was taken of the amount of urine required to produce death, and of all the symptoms. One of the most marked symptoms was found to be a rise of temperature—the temperature of the rabbit increased from three degrees to five degrees F. within five minutes from the time the injection was begun. The temperature was taken per rectum both before and after the intravenous injection, and the greatest care was taken to secure the highest degree of accuracy possible.

This observation is not anomalous, as similar facts have been observed in the injection of the urine of patients suffering from typhoid fever and other febrile maladies.

The fever of a consumptive is due to the presence of tuberculin in the circulation. The fever in the rabbit was due to the presence of tuberculin in circulation which had been excreted by the consumptive through his kidneys. It will be admitted that the milk of a tuberculous cow must contain a much smaller proportion of tuberculin than does the urine of the same animal; nevertheless, since the fluid portion of the milk is made up from the plasma of the animal's blood, it is evident that it must contain at least as large a proportion of this extremely soluble and poisonous product as is found in the animal's blood—perhaps even a larger quantity,—the readiness with which toxic substances of various sorts are excreted by the mammary glands being too common an observation to require more than mention.

This matter is certainly one of most profound importance. Tuberculin is not destroyed by sterilization nor by any culinary process. If present in the animal when alive, it will certainly be present in its flesh and milk, and those who make use of these infected substances as food, must run an enormous risk of injury. From the results of the post-mortem study to which I have already referred, and by which we have learned that in large cities, at least, about one half of the poor population are more or less affected by tuberculosis at some time in their lives, it is evident that an equal number of those who make use of the flesh or milk of tuberculous animals are likely to suffer the greatest injury thereby, through the intensification of the tubercular process or the diffusion of the circumscribed disease.

Since sterilization affords no certain protection from this danger, it is evident that inspection is the only precaution to which positive value can be attached, and this inspection must be thoroughgoing; it must include not only an ocular inspection of animals, but the injection of tuberculin.

So thoroughly impressed was I with the importance of this method that, after reading Professor Law's paper, I immediately proceeded to secure a careful investigation of each one of the 112 animals which furnish milk for the hospital and sanitarium of which I have charge. The astonishing thing to me is that I should so long have remained apathetic to a question of so great importance. It has, indeed, many times occurred to me that the milk of tuberculous animals must contain more or less tuberculin, but I had never given the matter sufficient thought to become impressed with its importance. Prof. Law has certainly become a public benefactor in presenting this subject so forcibly and lucidly, and it is to be hoped that live stock commissioners and veterinaries everywhere will recognize the importance of this phase of the question, which has hitherto been utterly neglected.

There is still another feature of this question to which, it seems to me, sufficient importance has not been attached, namely, the infection of human beings with tuberculosis by contact with tubercular animals, aside from the use of their flesh or milk as food. That tuberculosis is usually contracted by the reception of germs into the air passages is a point upon which there will probably be no controversy. The reception of the microbes in the form of dust, by

respiration, is unquestionably the most frequent form of contagion. A case which once came under my observation may be worthy of mention, although it seems hardly necessary to add to the vast amount of positive evidence which has accumulated within the last ten years. On inquiring the history of the case of a lady suffering from tuberculosis, who came under my care some five years ago, I was informed that her husband had died of the disease some two years previous. During the last two months of his life he was confined to his bed and expectorated enormous quantities. The family resided upon a Nebraska farm, and were entirely ignorant of the nature of the disease, not being instructed by their physician. The housewife, being busy with her household duties, and burdened with the care of several small children in addition to that of her invalid husband, often neglected to wash the clothes upon which he expectorated. She simply dried them and rubbed them up in her hands to restore pliability, thus reducing the infectious matter to powdered form and diffusing it through the atmosphere of the room in the most effective manner possible. She naturally contracted the disease herself, and when seen by me was in the very last stages, and died a few weeks later.

The *British Medical Journal* recently reported the following case, which indicates the tenacity of life in the bacillus of tuberculosis under ordinary conditions:

"A family of nine moved into a house occupied ten years previously by two tuberculous patients. A short time after, although the whole family had been in splendid health, three among them showed symptoms of tuberculosis. They used the same bedroom as the former tenants. Dr. Ducor had pieces of wall paper examined and dust from the ceiling and walls was also examined. In both cases the tubercle bacillus was found. The former occupants had been uncleanly in their habits; the sputa had dried on the walls, and the bacillus, as M. Vignal has shown, retained its vitality, and was not destroyed by attempted disinfection."

A recent number of the *Journal des Connaissances Medicales* reports some cases of tuberculosis which were contracted by the new occupants of an apartment contaminated by the expectorated matters of a tuberculous patient who had died there two years before.

Sawisky, who has investigated the length of time that dried sputum retains these infectious properties, reports that virulence

was retained for two and one half months. He found this to be true even when the sputum was exposed to the sunlight, the destructive effect of sunlight upon microbes, which is well known, being only observed in the bacillus tuberculosis when the sputum was spread out in very thin layers.

Flick has prepared a map of the fifth ward in the city of Philadelphia which locates every house in which tuberculosis has occurred within the last twenty-five years, and shows that the disease has chiefly prevailed in a series of infected houses which constitute less than one third of all the houses in the ward, but have furnished more than half the deaths. It was also observed that a large percentage of all the cases of mesenteric tuberculosis in children occurred in their houses.

Another fact in addition to those which have been cited, showing the danger connected with infected apartments, is the extreme liability to disease of nurses who care for consumptive patients. Cornet showed from statistics of 87,000 nurses, that 63 out of every 100 of them died of tuberculosis, the proportion of deaths from tuberculosis up to fifty years being 75 per cent. Is it not reasonable to suppose that the dairyman who cares for a cow suffering from tuberculosis is at least equally as liable to contract the disease from the cow?

A point of importance to which we wish to call special attention is the fact that the sputum of tuberculous cattle and the apartments occupied by such cattle are as dangerous a source of infection, and more so, than the sputum of human beings, or the apartments occupied by them.

Dr. Bell noted, in his observations previously referred to, that healthy cattle placed in stalls which had previously been occupied by tuberculous animals, soon became infected with the same disease. Doubtless the source of infection among animals is the same as that which prevails most frequently among human beings, namely, the inhalation of the infected matter reduced to powder and floating in the air as dust.

It is doubtless true that contagion from animal to man is much more common than from man to animal, and yet that contagion may occur from animal to man cannot be doubted. A case is reported in which a flock of chickens became almost wholly tuberculous through eating the expectorated matters of a consumptive

young man who had charge of them and fed them, spending considerable time with them in the yard.

Hoffman has shown that flies may take up the tubercle bacilli from infected sputum, and discharge them alive and active with their excreta. A number of flies fed upon infected sputum died after a few days. Whether death was due to the growth of the microbe or to the toxic effect of the tuberclin absorbed was not shown by the experiment. It is known that the bacilli of leprosy are communicated by flies alighting upon a raw surface, and I deem it quite possible that infection of the skin, resulting in lupus, or of the lymphatic glands, producing scrofulous enlargement, may occur in this way.

A curious fact to which attention has been called, is that earthworms may receive into their bodies and retain there in a virulent condition the tubercle bacilli for many months. These bacilli may be deposited upon the surface of the earth with the excreta of the worm, become reduced to powder, raised in the air by some passing breeze, and thus find their way to human lungs. In this way the expectorated matter of cattle in pastures may find access to human beings.

In licking herself a cow suffering from tuberculosis may soil the hair about the udder or flanks with infected saliva, which, after drying, may be rubbed off during the act of milking and find its way into the milk. This may be a source of infection of milk, in cases in which, when taken with special precautions directly from the udder, the milk gives no evidence of infection.

Numerous other ways in which tubercle bacilli may be communicated to human beings from an affected animal may be easily conceived. The extent to which tuberculosis prevails among cows and other domestic animals is a subject concerning which we are at present considerably in the dark, since no sufficient, thoroughgoing investigation has been made to give us definite and accurate information. The superficial examinations which are made in connection with slaughter houses and packing establishments have shown a percentage of infected animals as high as 2 or 3 per cent.

Jorissenne, who claims for the veterinary surgeons of Belgium the honor of first calling attention to the danger in the use of the milk of tuberculous cows, states that out of every hundred cows four are tuberculous.

It is evident that safety from this source of danger to human life can be found only in a thorough inspection, not only of all cows and cattle furnishing food for human consumption, but of all domestic animals which are subject to this disease. The astonishing thing is that there should be so little interest in relation to this question. Tuberculosis is a disease which is much more rapidly fatal in its effects, much more actively contagious, than the much dreaded leprosy of India and the South Sea Islands, and is almost equally fatal when it has obtained a foothold in the human system.

The results of the inquiry made in India by the leprosy commission recently appointed by the British government, show that leprosy is not propagated by direct contagion from one human being to another, but through the air, doubtless by means of fine particles of dust carrying the germs of the disease. Leprosy germs were found in the dust gathered from a ground surface over which a leper had walked. Consumption also is doubtless most frequently communicated through the medium of dust.

Another interesting fact is found in the pathological resemblance of the two specific microbes characteristic of these diseases. The appearance of the two germs is almost identical. Indeed, their resemblance is so close that a bacteriologist of some note has recently come forward with the assertion that they are absolutely identical; in other words, that the disease commonly known as consumption, or tuberculosis, is only another form of the disease commonly known as leprosy. Certain it is, that consumption is a disease much more to be dreaded than leprosy. A malady which destroys more than one sixth of all who die in this country must have some cause which is very general, very potent, and withal very subtile. It is not to be wondered at that there has been much discussion with reference to the nature of this cause. If it had been very easily discernible, it would long ago have been fully recognized and would have been suppressed.

It is the firm belief of the writer, however, that the wonderful development in bacteriology and physiological chemistry which the last decade has witnessed, has brought to us a solution of this question, and that it only remains for sanitarians to grapple with it resolutely and to urge upon national, state, and municipal authorities everywhere the duty of undertaking a thoroughgoing and unrelenting crusade against a disease which is annually responsi-

ble for more deaths than war, pestilence, and famine combined; a disease which has been very aptly demonstrated "The Great White Plague," and which is, in the light of modern researches, as proper a subject for public health measures, restriction, quarantine, and isolation as small-pox, yellow fever, or cholera.

The boards of health of several states have considered the matter of sufficient importance to send out in great numbers, pamphlets warning the public with reference to the necessity of destroying the sputum of consumptives and carefully disinfecting the premises which have been occupied by them. Similar steps have been taken in England. The health officer of the city of Manchester, England, advertises himself as ready to disinfect, free of expense to the owner, apartments which have been occupied by consumptives.

More than two years ago the government of Prussia took cognizance of the importance of this question, and issued an admirable publication, including a series of rules relating to the prevention of this disease. Tubercular midwives are forbidden to practise their profession. Town corporations are recommended to provide disinfecting apparatus for the disinfecting of infected houses and clothing. It is certainly high time that attention should be given to two of the most important causes of this disease—the use of infected flesh and milk and the contact of human beings with infected animals. Consumption should be classed with other contagious diseases, and treated in a manner consistent with known facts relating to its contagiousness. State and municipal authorities should require a careful inspection of the meat and milk supplies of all public institutions.

I considered it my duty to make an investigation of this sort in relation to the milk supply of the institution of which I have charge. The investigation was made under the supervision of the state veterinarian of Michigan, who employed tuberculin furnished by the department of agriculture in Washington, in accordance with the rules laid down by the department for such investigations. Although not a single case of tuberculosis was found among the one hundred and twelve cows examined, I shall continue the application of the test, and hereafter will admit to the establishment no milk which is not furnished by animals which have been subjected to the tuberculin test. The fact that occasionally instances are found in which large herds of cattle are entirely free from tubercu-

losis, renders all the more important a thorough investigation of this matter, as it emphasizes the contagious character of the malady and the possibility of the complete eradication of the disease.

In the discussion of a paper which I presented at the National Live Stock Sanitary Convention held at Washington, D. C., last June, from which a part of this paper is borrowed, Dr. Salmon called attention to the fact that the old idea that only 3 or 4 per cent. of cattle about Washington were infected by tuberculosis, has been proven to be incorrect, since an examination of a herd of 100 head has shown that 80 of the cattle were infected by the disease. Physical examination alone is not sufficient to demonstrate the presence or absence of tuberculosis. The tuberculin test is the only reliable means of discovering the disease when it is in the incipient stage. Even this sometimes fails on the first test, but a second test is pretty certain to succeed. The test is easily made.

The herd is kept in over night, and in the morning the temperatures are taken per receum. This is continued every two hours for twelve hours. At the end of the twelve hours, 30 m. (2 c. c.) of Koch's tuberculin is injected hypodermically, and the cattle are allowed to rest over night. The next morning the temperatures are again taken, and continued to be taken every two hours during the day(12.) A cow's temperature is about 101 degrees F., and if any have tuberculosis, the temperature will rise to 105 or 106 degrees F. The cattle are well fed and cared for during this time, but kept quiet.

This method has been so thoroughly tested that it is now employed by the State Board of Health of New York, in which state the matter is receiving great attention. The National Department of Agriculture at Washington is also taking active measures in reference to this matter and supplies to state veterinarians, free of charge, the material necessary for making the tuberculin test.

It is the candid opinion of the writer that if this subject were appreciated as it should be, and such measures adopted as might be adopted, and such as would be adopted if the people fully appreciated the gravity of the subject, tuberculosis, not only in cows, but in human beings as well, might be practically stamped out of existence within a generation.

If this could be accomplished, it would result in the saving of a vastly greater number of lives than have been saved by quarantine

and vaccination against cholera, yellow fever, and small-pox. Co-operation on the part of national, state, and municipal governments in making investigations of this sort obligatory, and furnishing facilities for such investigations, would, I believe, result in the saving of many thousand lives annually, and might, within a few years, almost wholly eradicate a very important and rapidly increasing cause of tuberculosis in human beings.

The conditions under which milk is usually produced in civilized communities are such as to insure its contamination. The udder and other portions of the body of the cow become smeared with her excreta, or that of other animals, and this infectious material is in turn rubbed off by the contact of the hands and clothing, or the switching of the animal's tail, and falls into the milk during the process of milking. The amount of foreign material of this sort which finds its way into the milk, depends, of course, upon the care of the dairyman. Milk from cows in pasture is comparatively free from materials of this sort, although by no means wholly so, while milk from cows kept in stalls is certain to contain a considerable quantity of stable litter.

The average dairyman unwittingly imitates a heathen custom. The Hindoo, as already stated, makes no use of milk as an article of food, but often keeps cows for the purpose of supplying milk to his English and Mohammedan neighbors. The rules of his religion, however, require him to placate his deity for robbing the cow by performing certain religious rites, one of which consists in adding cow dung to the milk.

Incredible as this statement may appear, I am certain it is authentic, as the statement was made to me by missionaries who had spent many years in India and were personally knowing to the facts.

I was also informed that a great objection to the use of milk in India is the fact that it is invariably found to possess a strong flavor of cow dung.

This objection not infrequently applies with a considerable degree of force to United States milk.

When it is considered that in the cow's excreta are to be found germs of many varieties, form the ordinary germs of putrefaction to the most deadly pathogenic or disease producing microbes, and requiring only a favorable soil in which to develop to enable them to manifest their deadly properties, it will be seen that no small

importance attaches to what is generally considered an insignificant or unimportant matter.

The housewife is ordinarily contented with straining the milk through a wire-cloth strainer, or, if exceptionally fastidious, she may employ a strainer of cloth. The universal practice of straining milk in some fashion is a recognition of the source of contamination which has been mentioned. But it probably is not generally known, at least not considered, that this mode of purification removes from the milk only the coarser masses such as are readily visible to the eye.

A microscopic examination of the milk obtained from a cow in the ordinary manner shows that after the most careful straining it still contains a large number of germs and germ spores, which at the end of a few hours are found to have increased with such rapidity that thousands are to be found in every drop of milk, and at the end of twelve hours the number is often increased to millions.

It is to these germs that the souring and decomposition of milk are due, and also the various characteristic changes which take place in cheese, and other less usual phenomena connected with milk.

Pasteur, Freudenreich, and many other eminent bacteriologists have made a careful study of the different germs found in milk and with most interesting results.

Investigations conducted a few years ago at the experiment station of the State Board of Health of Connecticut resulted in the discovery of more than thirty different kinds of germs in milk.

In conclusion I desire to say one word with reference to proper methods in the production, care, handling, and use of milk.

1. Cows must be fed upon proper food. Cows fed upon garbage soon suffer from indigestion, and the milk is thereby deteriorated in quality, not only by the poisonous products of decomposition communicated by the garbage through the cow to the milk, but also by the products of indigestion in the cow, which are equally deleterious in character, and which find their way into the milk from absorption and secretion by way of the mammary gland.

2. A cow must be supplied with an abundance of pure water. The same care should be taken to provide as pure water for a milch cow as for a human being.

3. The milch cow should receive the most scrupulous care as

regards cleanliness. When a wet-nurse is to be selected for a young child, the nurse is usually required to bring a certificate from a physician that she is in sound health. A wet-nurse suffering from a skin disease, serious indigestion, decayed teeth, bad breath, or a constitutional taint of any sort, or who is of untidy habits, is at once rejected.

It is very remarkable indeed that we have been so slow in recognizing the fact that a cow is a wet-nurse for the entire family—the father, mother, older brothers and sisters, as well as the infant members of the family. The cow should be kept indoors only during the coldest weather, and should have daily exercise out of doors in all weathers. The stable should be airy and well ventilated, thoroughly clean and free from stable odors; the cow herself should be kept thoroughly clean, and unless allowed an opportunity to groom herself in a natural fashion, should be as regularly and thoroughly curried as a carriage horse. Before milking, all the parts liable to contribute anything to the milk pail should be thoroughly clean.

4. The dairyman himself should be neat and tidy in his work. The vessels which receive the milk should be protected, so far as possible, from stable dust. In the investigation conducted at the Connecticut experiment station, among the germs found in the milk was one species which produced the familiar characteristic odor of the cow-pen, another gave that of a chicken-coop, another produced the odor of the pig-sty. The odors produced by the other germs were equally characteristic of their origin.

To avoid the reception of germs and the absorption of poisonous volatile substances produced by the various germs which thrive in the vicinity of the stables, the milk should not only be protected while in the vicinity of the milking stable, but should be removed as quickly as possible.

5. The milk should be quickly cooled after milking; not that there is anything injurious in the animal heat in the milk, but heat favors the development of the germs which, in spite of all ordinary precautions, are certain to be present in small numbers at least, while cold discourages the development of these organisms. A certain period of incubation takes place after the collection of the milk from the cow, varying in length from an hour or two to several hours, according to the temperature of the milk.

Experiments made in Germany have shown that milk which is cooled rapidly after milking, so that the period of incubation is sufficiently extended to allow of the consumption of the milk before the incubation is completed, is much less likely to produce disease than milk in which this precaution is not taken. The observations referred to were made upon a large number of children fed upon milk from various sources and treated in different ways. In all cases in which sickness could be traced to the milk it was found that the precaution of cooling the milk had been omitted, while those infants who were fed with milk which was promptly cooled after milking and kept cool, were almost wholly free from disturbances from this cause.

Cases of tyrotoxicon poisoning have been traced to the neglect of this precaution.

6. The milk-containing vessels themselves may be a source of contamination of milk. This is a matter with which every housewife is acquainted.

Milk put into vessels which have not been properly scalded, promptly sours. Such milk, even though it is eaten before souring or other decomposition has occurred, is likely to produce disease in young children and other persons of feeble digestive powers, as the process begun in the pan is continued in the stomach. This is one of the reasons why fresh milk from the cow frequently agrees with invalids or with young infants when milk can be taken under no other conditions without injurious results.

If the above mentioned precautions are adopted and care is taken to ascertain that the animal from which the milk is taken is in a fairly healthy condition and remains in a healthy state, no danger may be apprehended from the use of milk; but until the general public have become much more thoroughly educated upon this subject than is likely to be the case for some time to come, a wise precaution which may be safely adopted as a routine practice in the use of milk is sterilization or Pasteurization.

Sterilization consists in raising the temperature of the milk for a few minutes to the boiling point, or a few degrees higher. If the milk is heated to the boiling point or a temperature of about 210 degrees for a few minutes, all deadly germs and most other germs will be destroyed.

A few spores, however, are almost certain to escape, so that milk

which has been merely boiled will not keep indefinitely. For this, it is necessary that the temperature should be raised several degrees above the boiling point, or to about 220 degrees and held at this point for ten to twenty minutes. The higher temperature named may be obtained by placing the milk in bottles, tightly corking, and boiling while immersed in a saturated solution of common salt. It is necessary to leave the bottles in the solution until it is cool, as they will break if suddenly removed from the hot solution.

Objections have been raised to sterilization on the ground that it changes both the flavor and to some degree the composition of the milk at the same time that it destroys the microbes which it contains. To meet these objections the method known as Pasteurization has been proposed. After using this method on a large scale for several years, I can heartily commend it. It consists in heating the milk to a temperature of 158 degrees and keeping it at that point for fifteen minutes. Exposure for this length of time to the temperature named will destroy typhoid fever germs, and all other disease producing microbes which are at all likely to be found in milk, although it will not destroy all germs capable of souring milk or producing other forms of decomposition. The germs which produce decomposition of casein, such as takes place in the formation of cheese, require a temperature above that of boiling water. Pasteurization consequently cannot be depended upon for the long preservation of milk, but when carefully done, it is found that milk thus treated will keep from one or two days longer than raw milk. By the daily repetition of the process it is, of course, possible to preserve the milk practically unchanged for almost an indefinite length of time.

It should be mentioned that it is important to cool the milk rapidly after heating, as Pasteurization merely prolongs the period of incubation or development of many of the germs which it contains, and it is important to maintain as low a temperature as possible after the heating, as heat greatly favors the process of incubation, or development.

This method of treating milk preparatory to using it is by no means as troublesome as it may appear. There are no obstacles whatever to its practical adoption on a small scale in private families, and its use on a large scale is not a matter which offers any considerable difficulties. For the last five years I have had Pasteurized or sterilized all the milk consumed in the institution of which I have

charge, amounting to 1,200 to 1,500 quarts daily, and the work has been accomplished by very simple arrangements. After the removal of the cream with a centrifugal separator, the milk is heated in large double boilers and afterwards placed to cool in ordinary creamery tanks furnished with long, narrow receptacles.

So far as I can learn from inquiry, the milk supply of Union City is essentially that of most interior towns, neither better nor worse. It is certainly much superior to that of our large cities, but it is exposed to all or at least most of the dangers which have been pointed out in this paper, and doubtless is responsible for a certain proportion of the deaths which annually occur in the community.

The most serious dangers to which attention has been called are not those of an extraordinary character, such as cholera, typhoid, and other epidemic infections, but the ever present danger of infection from tuberculosis and to injury from the deleterious effects of the germs constantly present in milk collected and used under ordinary conditions.

If some of the conclusions of this paper seem to be overdrawn and the recommendations impracticable and fastidious, I shall neither be surprised nor offended, for the history of sanitary progress shows that at every advance step in the direction of improved hygiene this same obstacle has been met and surmounted.

INDIVIDUAL COMMUNION CUPS.

BY ELLEN A. WALLACE, M. D., STATE SUPERINTENDENT OF HYGIENE OF THE WOMAN'S CHRISTIAN TEMPERANCE UNION.

One year ago an apology was required for proposing or discussing any change in the manner of administering the sacrament at the Lord's table; now the question of individual communion cups is so freely discussed by clergy and laity in religious, scientific, and secular journals, that no such apology is needed, although we must always approach this subject with a spirit of reverence, not only toward Him who said, "Drink ye all of it," but toward all the generations of these nineteen centuries who have observed this sacramental rite.

As the advance of science shows the ways in which diseases are communicated, we should do all in our power to avoid such communication by our customs, be they in the family, travelling car, school, or church. Certainly the church, aiming to do all she can for humanity, should be ready to remove danger from her own flock as soon as such danger is discovered. And when we know how many churches all over the country, and of nearly all denominations, have changed their custom during the short time this question has been agitated, we believe that all will be ready to act as soon as they can be made to realize the importance of the movement.

Those who are working for the better sanitary condition of our country and of our state, who are aiming to decrease our death-rate by the avoidance of contagion, should agitate this question thoroughly and everywhere advocate the removal of the common drinking cup, educating the people to realize its dangers and their duty respecting it toward their fellowmen. During the past year many

county and state medical societies have adopted resolutions recommending to churches the use of the individual chalice for the communion service.

There is no question that many diseases can be transmitted by the secretions of the mouth; in the present manner of communion these secretions enter the cup and also adhere to its edge to be removed by later communicants. At a recent meeting of the Monroe County Medical Society, in New York, an epidemic of diphtheria was reported by one of the health officers. This epidemic was confined to a single school district, twenty-four families being afflicted. The contagion was traced back to the drinking cup used in school and used by the diphtheritic children, microscopic examination revealing the diphtheritic microbes adhering in great quantities to its rim. Another epidemic has been reported from California in which it was believed the communion cup was the cause of the spreading of the disease.

Dr. Albert Ashmead writes for publication the following which illustrates frequently existing conditions: "The last time I knelt at the communion altar there knelt at one side of me a patient whom I knew, as I was treating him at the time, to be suffering from an odious disease; his mouth contained patches which made it especially contagious. This person took the cup before it came to me; of course I let the cup pass. At another time the person next to me, but following me in the use of the cup, was also a patient of mine in an advanced stage of tuberculosis; the mouth of this patient was in a condition dangerous to his neighbor."

Many pathologists have made microscopic examinations of the wine remaining in a common communion cup after service and have found abundant proof of its power of contagion. We will refer to but one of these. Dr. H. S. Anders of Philadelphia writes, "In May last I found in two out of five specimens examined from a communion cup the following several bacilli of tuberculosis: staphylococci of pus formation, numerous pus cells and epithelium from the mouth, showing the dangers inherent from promiscuous contact."

Certainly the custom of returning to the bottle what is left in the cup after service should be abolished. Investigation reveals this to be the custom of many churches, and some even send that bottle with its rinsings of lips and mustaches and its accumulation of

microbes to the sick of the parish who in their weakness are especially susceptible to contagion.

Many have said, "I cannot remember the time, when partaking of the sacrament, that I did not watch the cup which would come to me, my spirit of devotion being affected by the amount of satis faction or repulsion which followed such observation."

Certainly we should consider it unclean for all to drink coffee from the same cup at a church social; why, then, is it strange that many have the same feeling at the Lord's table? If it has been rightfully advocated that, if the common cup is thus offensive to many, if it usurps the place of Christ in the sacred memorial, a remedy should be sought for and applied. We are told that when Leonardo da Vinci, the celebrated historic painter of Italy, was engaged upon his great painting upon the wall of the convent of Santa Maria delle Grazie, The Last Supper,—representing the Saviour and his disciples at the paschal feast, each supplied with an individual portion of bread and an individual vessel of sacred wine —a person was invited to examine the work, who soon began to enlarge upon the beauty of the chalice; the painter immediately dashed his brush across the object of admiration, because, he said, he had made a mistake in not so painting the picture as to make the face of the blessed Master the centre of attraction.

It is argued that when the common cup is discarded, we abolish the spirit of unity which Christ sought to exemplify; not so,— churches adopting the individual cups testify that partaking in unison and bowing in prayer at the same time, increases the spirit of fellowship.

By their use the service is shortened, the attendance is increased, for each member is made to realize that a cup is filled for him and put upon the Lord's table and if it is not taken it shows by its presence the absence of the owner.

There have been various changes in the method of administering the sacrament,—in some ages the bread and wine were mingled together, in some the priest partook of both emblems and the people only of the bread; at one time the wine was imbibed through a tube called a fistula, at another the eucharist spoon was used, and at still another each communicant took to the altar a small vessel in which a portion of the mingled bread and wine was placed, then carried to the lips. Thus from history we learn that the spirit of the ob-

servance is the one great matter of importance, but the method is subject to change, according to the civilization and the customs of the times. Even where the common cup is used, the number is increased to two, ten, or twenty for convenience; considering this and the example of previous generations, need we hesitate to advocate a change for cleanliness and health which shall be of benefit to our fellowmen, if it does not destroy the sacredness of the memorial?

POTABLE WATER.*

BY EDWIN J. BARTLETT, M. D., DARTMOUTH COLLEGE.

Potable water is drinking water. Drinking water is held to the same high standard as Cæsar's wife. But water after it has left the heavens and started on its earthly career, not only goes downwards, but keeps bad company; it consorts with the effete, the putrescent, the excrete, the vegetable extract, and the soluble mineral. The rank slops from the kitchen sink, the rich leaching of the neglected barn-yard, the flushings from the water-closet, the dirty waste from the factory, the drainage from the grave-yard on the hill, the products from vegetable and animal life and death, are all received into the liberal water courses. And from below, the salt beds, the iron ores, the epsom salts and the lime deposits are drawn along by its solvent power. The deadly typhoid bacillus, the ovum of the tape-worm, the beneficent nitrifying bacterium, find a temporary home in its all-welcoming current. And all the gases or fluids occasionally or constantly in the air, are greedily niched into its surface.

In populated districts the presumption is against its purity; while in upland springs where only the sky and unoccupied land are above the presumption is favorable.

SOURCE OF DRINKING WATER.

For drinking purposes water is taken from wells and springs, and from reservoirs, either natural or artificial, of surface water.

A well is a hole in the ground, and its contents may be the

* Read before the New Hampshire Medical Society.

unfiltered drainage from a filthy surface, or well filtered and oxidized water from a deep spring.

The spring water has passed through the soil, the sand, and the gravel to emerge at a lower level, filtered and oxidized, but carrying mineral constituents from the materials with which it has come in contact. In its best estate it is the most satisfactory water in nature, colorless, cold, and organically pure. And no springs are purer than those from the hills of New Hampshire and Vermont.

The surface water varies with source and environment, but carries the washings and drainage of the surface over which it runs, is usually perceptibly colored, and is an unsatisfactory, though necessarily common, source of supply. The large city supplies are guarded only by constant vigilance and continuous observation. Each of the six supplies from the Thames to London is examined and reported upon daily.

IMPORTANCE OF THE SUBJECT.

Now mankind, with a few exceptions, drink water. It is the one common condition with reference to externals except breathing air. The uninstructed naturally drink the nearest water that is tolerable. The well informed must drink, if not supplied with good water, the best to be had. Even the simple and usually efficient precaution of boiling the water for a few minutes is irksome, and most of the few who know the risk prefer to take it. But water is a pregnant source of disease, both specific and general. Two of the most fatal diseases of humanity, Asiatic cholera and typhoid fever, are disseminated chiefly, if not exclusively, through drinking water. From its nests on the Ganges, from the sacred well at Mecca, where the pilgrims wash in the water and drink the washings which return to the well, the comma bacillus starts on its deadly travels. The German Health Commission reported the cholera epidemic at Hamburg as directly traced to an inconceivably filthy history and condition of the waters of the Elbe, including specific infection.

Much nearer home is the typhoid fever, whose propagation is well illustrated by a few famous cases; such as the milk

route at Springfield, the high Chicago death rate before opening the four-mile intake, immediately lowered after; the Lowell and Lawrence epidemics of 1890; the St. Johnsbury epidemic more recently when the drinking water of the village came in part from the Passumpsic river below a region infected with typhoid; and the deadly epidemic at Windsor this spring.

Among the interesting facts obtained from the study of the Lowell and Lawrence epidemic, it was shown that a bacillus might reach Lawrence in eight hours from Lowell, that it might survive twenty-four days in Lawrence water, that a run of six hundred and seventy-five miles at the rate of the Merrimack would be needed to remove all bacilli from the water, that the bacilli might drop in the mud and propagate there, and best of all that proper filtration could remove all bacilli from the water.

More often, however, than by infecting with specific disease, bad water acts to pre-dispose to disease by reducing the power of resistance.

HISTORICAL OUTLINE OF THE SUBJECT.

With a partial and increasing appreciation of these conditions, sanitarians have devoted much study to drinking water. Without attempting to bring together any continuous historical account, it may be stated that important literature upon the subject begins about 1850, has a marked impulse about 1868, and that the last decade has borne an indigestibly rich literature of experimental data and conclusions.

The home of chemical methods is in England, of bacteriological in Germany, and it has seemed to be for the sanitarians of America to make the most fruitful, rational, and serviceable applications and modifications. In England the eruptive warfare between Wauklyn and Frankland has stood seriously in the way of unity and sound progress.

In the United States the wonderfully enlightened policy of the Commonwealth of Massachusetts in maintaining a corps of the ablest workers to be had, untrammeled by politics, in a long series of systematic researches has been a source of rich knowledge to the world, and nothing can be said upon either

water or sewage without constant reference to the Massachusetts work.

CAUSES OF CONFUSION.

Throughout this working period even to the present time two general causes of uncertainty and confusion have prevailed: First, a difference in methods and countless variations in practising the same method, and second, an uncertainty of interpretation due to the fact that the chemical, microscopical, and generally the bacteriological methods furnish only circumstantial evidence. Fuller reference will be made to both these points; but upon the second, the interpretation, it may be said as essential that the thing which does, or causes, harm in water, rarely exceptionally, almost accidentally is revealed. Failure to discover the bacillus of typhoid does not clear the water of suspicion of the gravest kind if typhoidal dejecta have passed the water. Nor will any amount of chlorin and ammonia convict a water of sewage pollution if it cannot possibly have met with sewage in its earthly career. Nor can it be said with any certainty from the albuminoid ammonia in the brown peaty waters that the water will in any way affect the health of the consumer.

ABSOLUTE STANDARDS NEARLY IMPOSSIBLE.

Almost inevitable but as hopeless as the search for the philosopher's stone, has been the effort to establish criteria of circumstantial evidence upon which all waters may stand or fall. Alone, unenforced by comparisons or by positive evidence, the organic nitrogen and carbon ratios of Frankland, the albumenoid ammonia of Wanklyn, the fifty colonies of bacteria of Koch, the consumed oxygen of Tidy, excess of chlorids, presence of nitrites, butyric fermentation, all fail in critical cases. Either unpolluted waters are condemned or polluted waters are endorsed. It is as if legislative enactment or judicial decision were to define the evidence which should in all cases convict of murder a man who was not seen to do the deed. Out of this desire for analytical positiveness has grown a tendency to shut the eyes to the most convincing and valuable of all evidence—the sight of the sewage flowing into the water, and to speak evil of a water that can prove an alibi.

This should not be misunderstood. The comparative condition of the same water can well be traced from day to day or month to month; a good or a bad water generally discloses its character to analysis; but when it comes to a positive opinion on a single sample all criteria may fail.

PURPOSES OF WATER ANALYSIS.

The various modes of water analysis have certain distinct and definite ends in view. The limits of this paper will not permit a careful tracing of the lines of evidence in each direction; but for one purpose one kind of evidence is valuable, while for other purposes it may be worthless.

In brief summary it may be said that water is examined (1) to pronounce on its general fitness for drinking supply (infection with specific disease being excluded). (2) To establish fitness or unfitness for various industrial uses, like brewing, paper-making, steam-making. (3) To study scientifically its history through considerable periods, including the efficiency of processes of purification. (4) To pronounce upon the sanitary condition of a water otherwise good, including its certainty to cause either general or specific disease.

For the first three lines of investigation—general fitness for domestic and industrial uses and history—the processes in use, though not perfect, are fairly satisfactory. To answer pointedly the very important question, Will this water to-day cause typhoid fever or diarrhœa or any other ailment? no one is able upon any single examination, or any number of chemical analyses. Repeated biological examinations, by competent hands, will often but not always afford an answer.

METHODS OF INVESTIGATION.

The methods of investigation may be grouped into five divisions:

1. A study of the environment.
2. Microscopic examination of the sediment.
3. Bacteriological examination.
4. Physiological tests.
5. Chemical analyses.

ENVIRONMENT.

The first method—the study of environment—is sadly unappreciated, but is in many cases the simple, efficient, incontrovertible, common-sense method. If you are doubtful whether your cesspool drains into your well the chemist may help you find out, but if you know it does, what more is to be said? With typhoid at Windsor who wants to drink the water of the Connecticut at Bellows Falls, though one hundred analyses show no peculiarity in the water?

It is a serious matter to condemn a water supply, but it is more often serious not to condemn it. Suppose,—and this is merely a supposition since the facts seem to be in question,—but suppose that there was a case of typhoid on the water-shed of the Windsor reservoir, from which the dejecta ran to the basin, then the youngest neophyte in medicine might stand with all the authority and sternness of a Hebrew prophet and say, "Thou shalt not drink this water," and a convocation of all the chemists and biologists in Christendom could not contravene his position, at the time. By inspection, too, are established normal, unpolluted waters which furnish an essential standard of comparison in the examination by any other method.

MICROSCOPIC EXAMINATION OF SEDIMENT.

The organisms not bacteria have long been studied in drinking water. McDonald's classic work appeared in 1875.

The most perfect method at present is probably the Sedgwick-Rafter method, in which the organisms are collected by filtering a considerable portion of water (500 c. c.) through chemically clean sand and are afterward washed out with distilled water; enough of this distilled water to represent 100 c. c. of the original sample is put on a cell slide divided into 1,000 parts; the animal, vegetable, and amorphous residue is counted and identified in from twenty to fifty of these divisions. As illustrative of the imperfection of the previous (and perhaps of the present) methods, it appears that this method gives from two to four times as many organisms as the method it displaced, and the displaced method gave several times as many as the one which it had superseded. A great deal of work has been, and

is being, prosecuted in this direction but I am not able to generalize the results.

BACTERIOLOGICAL METHOD.

The bacteriological method takes 1 c. c. or less of the water in the freshest condition possible, incorporates it with culture media, places it in a condition favorable to growth and counts or in some cases especially cultivates the colonies which develop, the assumption having been that each bacterium in the original specimen develops a colony in the culture. For a time fifty colonies per cubic centimeter was considered the limit of approval.

It is true that some of the purest natural waters are nearly sterile and that sewage may exhibit millions of germs in a centimeter; but it is now generally recognized that this method has almost no value in a single examination. The most deadly germs are discovered only exceptionally; no one culture can be obtained for all the germs; the method of counting does not distinguish between pathogenic and non-pathogenic germs; the water is often better because of the germs, it is likely that germs developing below the temperature of the body have little or no effect upon it; and then the germs multiply enormously in the same sample in a very short time.

This method has its main value when repeated upon the same water under similar conditions, and is especially useful in determining the efficiency of filters and other purification processes.

THE PHYSIOLOGICAL METHOD.

The physiological method is an approximation to the root of the matter. The fundamental question about a drinking water is not how many bacteria or how much nitrogen it contains, but what is to be its sanitary effect; and physiological tests aim to answer that question. Physiological tests upon rabbits had oddly perverse results in the hands of Professors Martin and Hartwell during Mallet's investigations in 1881. Out of the thirty-eight waters reasonably believed to be infected and pernicious from their history, not one was reported dangerous from its effect upon the rabbits, while on the other hand water containing infusion of leaves affected the rabbits badly.

Vaughan, in an elaborate paper published in the *American Journal of the Medical Sciences* in 1892, details what is probably the most careful and hopeful of the physiological methods. He makes gelatine cultures for counting and study, and beef tea cultures for inoculation. The beef tea cultures are kept in an incubator at 38°, the temperature of the body. After about twenty-four hours white rats are inoculated in the abdomen from these cultures. If the animals die plate cultures are made from their spleen, livers, and kidneys for study.

His conclusions are (1) that germs not growing at the temperature of the body are not capable of producing disease. "It matters not," he says, "how rich a given sample of water may be in these germs, if it contains no others it cannot be said that the water is a source of typhoid fever. The freedom from typhoid fever of communities using such waters seems to justify this conclusion. Such a water may not be, and certainly often is not, a desirable drinking water. It may be turbid with suspended matter, unpleasant to the taste, and give off a disgusting odor, but there is no evidence that it can cause disease." (2) Of the germs which grow at 38°C. or at a higher temperature some are fatal to animals when injected sub-cutaneously, while others are not. This renders possible a division of them into toxicogenic and non-toxicogenic. (3) There is no proof that the non-toxicogenic germs can multiply in the animal body. This does not furnish proof that they might not develop in the body of man. Waters containing these have not been positively condemned, but in some cases it has been advised that their use should be discontinued. (4) Waters containing the toxicogenic germs have always been condemned.

Dr. Vaughan had studied thirty-one water-germs; of these seven grow well above 38°, two or three others feebly. Four are toxicogenic. He has tried these by six methods of culture, all of the seven developing above 38°, and three others grow in "Parietti's Solution."

This method, however, and any method depending on the evidence of a single sample must often be indecisive in its negative results, because of the impossibility of knowing whether or not the sample represents the conditions of constant use of the water.

CHEMICAL METHODS.

The methods of chemical analysis have had, and at the present continue to have, greatly predominating influence in pronouncing upon the character of water.

There is growing and reasonable distrust of these methods exclusively applied. This is based upon the admitted insufficiency of the methods for all cases, the variety of results in various hands and the notorious mistakes in interpretation. These chemical methods do yield, however, valuable results, ample in some cases, suggestive or presumptive in others, and, when obtained in a rational series, historical and comparative. They do not touch the question of specific disease.

New Hampshire, Vermont, and Maine can not be said to have a definite system or policy in water work. Massachusetts has carefully studied methods, which Connecticut is closely following, so as a working system I will, in a general way, notice the Massachusetts methods, though of course not attempting accurate description of manipulative details.

The water analyst obtains his information from sources both physical and chemical, and reports under conventional and pretty well known headings.

The amount of *suspended matter* (which gives turbidity to the water) is determined by the difference of solids on evaporation before and after standing twelve hours. Suspended solids are usually easily removed by subsidence or filtration and do not play a very important part in water analysis. Though they were important at the time when one could get a dozen live minnows from a pail of Chicago water taken directly from the faucet, and minute particles of mica have produced serious irritation of the bowels.

Results are generally described in parts per million (which is milligrammes per litre) ; though in Massachusetts parts per 100,000 has long been the record.

Color is a mixture of bule and brown and is generally dependent upon the extractive organic matter from plants and leaves mixed with the color of pure water. There are several arbitrary standards. In England two wedges, one blue, the other brown, are slid one over the other till the color of the sample is matched.

The wedges are divided into 40 parts, and 20 : 30 would mean division 20 of the brown over division 30 of the blue matches the water. The color of Nesslerized ammonia is also used. Another arbitrary and seemingly very useful scale has been established by Mr. Allen Hazen by the admixture of a platinum and a cobalt salt. With a recognized and accurate standard any analyst can match the color of any water, and daily or periodical changes are matters of record. The chief objection to color is its unsightliness. In some of the most highly colored peaty waters it has been found that there was very little tendency to decomposition. Surface waters in this region are nearly always colored. With reference to colored waters stored in reservoirs the Massachusetts conclusion is that the color of waters exposed to the sun in open reservoirs is reduced by storage, but it must be stored for several months to cause any material reduction of color, and from six months to one year to remove all of it.

The *odor* of a water, like its color, is most satisfactory in its absence. We, at Hanover, have had a marked instance in the evolution of sulphuretted hydrogen from the new reservoir. Sewage imparts a characteristic odor which can detected by expert noses, in extreme dilution. The method is merely by smelling the water after it has been warmed in a covered beaker or flask.

The *total solids* or *residue on evaporation* is obtained by evaporating to dryness a measured quantity of the water and weighing. This constitutes an important factor in judging of waters for general use and in following the changes in water, but within the limits of service has little or no bearing on the sanitary character of the water. Most of the spring waters of this region have from thirty to fifty parts of solids per million, and the surface waters rather more than the upper limit. The normal surface waters of Massachusetts vary from forty in the eastern to sixty in the western part on an average. It would rather surprise a New Hampshire community to use the good water of English standards. "A water," says Fox, "should not possess more than [400 or 600 parts per million] of solids." It is customary to submit these solids to a red heat in a platinum dish and observe *phenomena and loss on ignition*. Organic matter

blackens and burns. On the whole, however, this process has little value and is discarded entirely in some laboratories, while in others it is done only with certain classes of waters and under carefully prescribed conditions. Mineral salts lose their water of crystalization during this process and some are decomposed besides.

The *hardness* of a water is the quantity of salts of lime or magnesium it holds in solution. These make the water literally hard, so that its sound when shaken in a closed bottle is distinctly different from that given by a soft water. The hard water uses up soap to form insoluble soaps of lime and magnesia before it will make a lather, and its hardness is commonly measured by the quantity of soap solution of definite strength which it uses up. Very hard waters are disagreeable to the body, expensive to the laundry, and rapidly encrusting in steam boilers, while soft waters are more corrosive to iron and more likely to carry lead from lead pipes. In England a careful comparison of the health of towns using very hard and very soft waters has been made, with the conclusion that if equally free from deleterious organic substances, hard and soft waters are equally wholesome. The Hanover aqueduct water has a hardness of 27.2 and the new reservoir of 19.2. The water furnished to London from the Thames varies from 230 to 450.

The *oxygen consuming power* is an important general consideration. It is commonly estimated by permanganate of potassium, a brilliant purple substance which readily parts with oxygen and loses color. Its evidence is general rather than special. A water using up oxygen in considerable amount is likely to be a water containing matter capable of putrefection. Of any single substance the most important is *chlorin* in water as a constituent of common salt, for the reason that salt is an invariable accompaniment of human excreta and of sewage. It is not the chlorin that is important, it is the source of the chlorin. It is the excess of the chlorin over that normally in the water of the same region. In this direction a remarkable work has been accomplished in Massachusetts. From a study of normal, unpolluted waters the whole state has been mapped out in iso-chlor lines. The least chlorin in a normal water is at North Adams, .6 per million, the most at Nantucket, 21.6.

They announce the law that the excess of chlorin is in direct proportion to the population on the drainage area. Four families or twenty persons add .1 to the normal chlorin.

There is a group of compounds all containing nitrogen to which also special significance attaches. They are called *free ammonia*, *albumenoid ammonia*, or *ammonia by permanganate*, *nitrites*, *nitrates*.

When organic matter of animal origin begins to decompose, one of the earliest products is ammonia; this is to some extent taken up by plants and turns up later as a product of their decomposition in compounds which by the action of certain reagents give off ammonia; this kind of ammonia is called albuminoid ammonia. Much of the free ammonia, however, is in the presence of bacteria oxidized to nitrous acid (whose salts are nitrites) and finally and stably to nitric acid (whose salts are nitrates). It will be seen then that free ammonia is to a certain degree evidence of very recent pollution with decomposing matter, that nitrites are intermediate products of imperfect oxidation, and that nitrates are the final permanent result of complete oxidation, but could not be present unless at some time the oxidizable material had been at hand. They are food for plants and hence seldom abundant. The albuminoid ammonia points to vegetable decay.

On account of the history of these substances thus briefly sketched, all harmless in themselves, much stress is laid upon their quantity, especially if it can be traced from day to day in the same water. They are like the sign board, which says "look out for the engine when the bell rings or whistle sounds."

The item in the chemist's report *nitrogen as free ammonia* is obtained by distilling the water and collecting the distillate in graduated jars, to these jars is added the Nessler reagent (so the process is called Nesslerizing) which gives a brown color with minute traces of ammonia; this color is matched by adding to ammonia free distilled water, known quantities of ammonia, and the difference between .002 and .001 per million is readily detected by the practised eye. Free ammonia is present with rare exceptions in all natural waters, in minute quantity and means, or suggests, according to its degree decomposition of

recent nature. Though called "free" it is seldom really free but is combined with carbonic or some other acid.

The *albuminoid ammonia* does not exist in the water as ammonia, but is made into ammonia by the reagents used. It may be of harmless vegetable, or decomposing animal origin; still it is not water and is not wanted in the water. Subjected to the action of a strong solution of permanganate of potassium in caustic potash the nitrogen compounds break up and produce ammonia which is distilled off and determined by the Nessler reagent like free ammonia.

The *nitrites* in the water are salts of metals with nitrous acid, the partially oxidized and unstable compound. On account of its transitory nature it is always when found taken as evidence of an unsatisfactory condition. Free ammonia, chlorin, and nitrites point straight to sewage. The nitrites are detetmined by a beautiful color reaction, the sample being matched by distilled water containing known and very minute quantities.

The *nitrates* represent salts of nitric acid, the more stable completely oxidized compound. Frankland has urged the nitrates as evidence of "previous sewage pollution." This view is commonly accepted, but not as affecting the water unfavorably any more than a scar suggests future danger. They are historical. They are valuable evidence in the daily or comparative study of water in showing what has become of the ammonia. Several quite technical methods are employed for their determination.

DIVERSITIES OF METHOD.

The distillation of ammonia will furnish an illustration of the endless variation of method even in carrying out a familiar standard process. A definite quantity of water is put into a retort and the ammonia and the albuminoid ammonia are distilled off in a cleanly manner, and the distillates treated with the Nessler reagent. The color is matched by a known quantity in the same volume of distilled water. Thus the quantity is determined. If this conveys a definite idea to the unchemical mind, the process doubtless seems so simple that a well instructed child could carry it out satisfactorily. As a matter

of fact, until one decides just how he will do it, no matter who rises as contrary authority, the whole process is as blurred to his mental vision as a revolving wheel.

Cleanliness means the absolute, tested, and proved freedom from ammonia of reagents, apparatus, hands, and rooms; the quantity of water used may be from 100 to 500 c. c.; carbonate of soda may or may not be added in the distillation; the condensing tube may be glass or block tin; cork, or rubber, or glass stoppers may be used; the receivers should be of one or another definite size and shape according to the manipulator; the rate of distillation is an open question; the number of distillates for free ammonia may be three, four, or until no more comes; the permanganate may be added to the residue of the liquid in the retort or to a fresh quantity from the same sample; the distillates may be Nesslerized at once or the next day; the Nessler reagent and the ammonia for comparison may be made up in one way or another; the report may be in nitrogen or in ammonia; in parts per million or per hundred thousand.

The report of oxygen consumed by a water is absolutely without meaning or value unless the exact method is known. It may have been done in twenty minutes, one, six, or twenty-four hours, and by several different methods.

From these variations, and many more, the results of different chemists, equally careful and accurate, do not compare at all well; while there is no place at all for the slovenly and inaccurate. On the other hand, any variation maintained uniformly and carried out accurately gives great comparative value to a series of analyses in the same laboratory. For instance, the Massachusetts board of health constantly distils three 50 c. c. jars for ammonia on the ground that they have worked out the adequacy of that procedure; Leffman & Beam recommend four, and the committee on water analysis of the A. A. A. S. recommend distillation till no more ammonia comes by actual test. The Massachusetts Board of Health continues to record its thousands of results in parts per hundred thousand while the general advice and practice is in parts per million. But the Massachusetts Board of Health has accumulated more valuable data on the subject than all the rest of the country put together.

ATTEMPTS TO UNIFY THE METHODS.

The prevailing confusion is by no means unrecognized or undeplored. In 1881 the national board of health undertook an elaborate examination of methods through J. W. Mallet and an able corps of assistants. Their report covers one hundred and sixty finely printed pages in the Board of Health Report for 1882. It consists of an examination of processes by using waters of known character. Very little has seemed to come of it, perhaps because it was an abstract investigation in which chemists most experienced in water work were not concerned. Among the negative results of this report was the endorsement of the Frankland process, but when seven years later a committee of the A. A. A. S. investigated over the same ground, it appeared, so far as the scanty replies to their circulars showed anything, that no one used this process. The biological work upon rabbits was unsatisfactory, as already mentioned; it appeared also that water containing fæces gave chemical results which might be attributed to vegetable matter in solution.

The general conclusions were:—

1. That unwholesomeness cannot be decided by chemical processes.

2. That these are secondary to source and history.

3. Gross pollution and departure from normal condition can be decided by chemical processes.

4. Local standards may be established.

5. Special value should be given to nitrites and nitrates, and many special recommendations were made upon the various processes tested.

In 1888, a series of questions were sent out to all well-known water chemists in the country by a committee of the A. A. A. S. The questions were also sent separately to subscribers to the *Journal of Analytical Chemistry*. Just seven replies were received. On the basis of these and their own views, the committee made a report. But after all, if the exact methods of Mallet, the exact methods of the A. A. A. S. committee, the exact methods of the Massachusetts board of health, and the exact methods of Leffman & Beam were followed, the analyses would not compare well.

POSITION OF AN INDEPENDENT CHEMIST NOT HAPPY.

The present position of a chemist not having the authority and resources of a commonwealth or large city at call, is not felicitous when asked to report upon a sample of water.

Unless he has sent his own demijohn and has had the sample taken by trusty hands, there is no certainty that the sample even decently represents the water. The difficulty is complicated by sending to another chemist a sample without considering it at all important to take the samples under similar conditions or to make sure that the dirt or vinegar or molasses left in one jug is equal to that left in the other. Even if the sample is correct, there is an uncertainty in comparison, for the reason that exact agreement can come only from exactly similar methods with the same reagents and the same samples. If one chemist gets his residue of ignition by adding carbonate of soda and igniting with a radiator, while the other conceives the residue to be that actually obtained without adding anything and igniting over a naked flame, the results will seriously differ though each may be correct according to the method.

Having obtained his results he can not interpret them with any certainty except in the case of some very good and some very bad waters. The results are data in a comparison, but in a single case he has nothing with which to compare. There is one standard for the Connecticut at Hanover, and another for it below Hartford, Connecticut.

The uncertainty is increased by the hankering after *blind* justice which possesses many people so that they sedulously conceal every item of information as to source and environment of the water. Typhoid fever was raging on the line of the Windsor, Vt., water supply, and only on that line. As if that fact in itself did not constitute a sufficient reason for letting the water alone, a sample was sent to Boston for analysis. But it was n't thought best to mention the little matter of typhoid to the chemist; they thought they would let him find out for himself. His report was very favorable to the water and was regarded by many as an impartial, and therefore trustworthy, pronunciamento. But the typhoid fever went on. Another chemist to whom the water was submitted with the facts, de-

clined to analyze, but pronounced it unfit for use. His view was thought to be biased!

SUGGESTIONS FOR THE MEDICAL FRATERNITY.

In reading a paper like this to physicians, who are for the public the immediate advisors and interpreters in sanitary affairs, a few conclusions if not based upon, at least suggested by, these statements may help to a better understanding.

NO ABSOLUTE STANDARD.

First and most important, there is no absolute standard of chemical results upon which all waters stand or fall. A chemist may condemn a water for some purposes and approve it for others; he may say this water is too filthy to use; he may say from previous examination this water is far below its usual condition; or this water is much inferior to similar waters of the region; or this gives strong evidence of excessive vegetable matter; or even, of sewage pollution.

CHEMICAL METHODS DO NOT CATCH DISEASE GERMS.

He can not say this water does or does not contain the germs of disease; his methods do not touch this question. If an astronomer spends the night in his observatory and in the morning when asked his results shows a column of figures and declares, "I find no snakes in Ireland," you think him crazy, but his methods enable him as well to say this as a chemist's methods enable him to detect the germs of disease. If a chemist reports at all upon the presence or absence of morbific germs it is proper to ask him what methods he used.

BIOLOGICAL METHODS PROMISE MORE.

The biological methods go farther than the chemical and repeated examinations accomplish valuable results. But the bacteriological methods do not permit the statement from a single sample that no pathogenic germs are in the water supply nearly so much as spending the day in the woods with a gun without seeing a partridge warrants the statement that none were in the woods. The physiological method, while little used, seems to have great promise. It is worth watching.

A PERFECT SAMPLE OF EXTREME IMPORTANCE.

The methods of water analysis are very delicate and the most absolute cleanliness in the sample is essential for reliable results. Samples taken by the unskilled are seldom fair. Samples taken at different times are often very unlike.

METHODS AFFECT RESULTS.

Chemists have not the same competence in this kind of work, but even when they have, there is a reasonable margin of variation from different samples, and a considerable margin from differing methods which may be equally correct. It is important, therefore, that the chemist be requested to state his methods of work. Usually there is a distinct disadvantage in sending to different chemists; if neither is honest or competent the results are worthless anyway. The repetition of analyses in the same laboratory with the same reagents, methods, and personal equation gathers value in going, while scattered results bring confusion and doubt.

TRUST THE CHEMIST, OR LET HIM ALONE.

Again, the chemist, if employed, should be trusted. The public, with a few enlightened exceptions, act on the principle that the water chemist is a mechanical appliance for accumulating data, and that the less he is informed about the matter in question, the more honest and reliable his data will be. He would perhaps have little cause to complain of this attitude, so long as it did not hamper his work and restrict his growth, if the public were content with the data, but they ask for a professional opinion in addition. That is, he is to throw away all his knowledge, and experience, and breadth of vision, and hazard his reputation on a guess; because his data commonly do not touch the question of absolute healthfulness of the water. This case is entirely different from asking an assayer to determine the ounces of silver in a ton of ore from a sample. Here outside facts have no bearing. But in the question of a drinking water every possible source of knowledge is to be desired, and it is the plain duty of the chemist either to give no

opinion, or to make it clear that his opinion does not go outside of his analytical data, which can tell him nothing about cholera, or typhoid fever, or diarrhea, or any other disease.

SYSTEMATIC STUDY OF WATER WOULD BENEFIT NEW HAMPSHIRE AND VERMONT.

The historical, comparative, systematic study of potable water is of great benefit and importance to a community even measured directly in dollars and cents. The states of Vermont and New Hampshire, with their throngs of summer visitors, their superb water sources, their frequent epidemics of typhoid fever, would be greatly benefited by elaborate modern study, and the world would profit by the examination and history of waters so pure at their source.

A BRIEF ABSTRACT OF THE VITAL STATISTICS.

The record of the vital statistics, carefully maintained from year to year, becomes of great importance to the state by indicating the movement of the population as well as determining certain conditions necessary to be known in order to formulate and carry out such laws, rules, and regulations as may be necessary for the greatest good of a community. Especially is this true in relation to the death records which form the true indicator in many instances for sanitary work. We are fortunate in this state in having already arrived at that period when the vital statistics have come to be of sufficient accuracy and completeness to make them valuable from a sanitary standpoint.

We are able to include in our observations the statistics of a decade, and to derive from them much that is of importance relating to the prevalence of the cause of mortality, and thus suggest to the health authorities certain lines of action in order to reduce an excessive mortality in a given locality.

The following tables, covering a series of years, chiefly from 1882 to 1893 inclusive, furnish reliable statistics relating to many phases of questions connected with the birth, marriage, divorce, and death records for the period named.

For a more detailed statement of the facts relating to the vital statistics of the state, reference is made to the annual reports relating to the registration and return of births, marriages, divorces, and deaths in New Hampshire, of which fourteen reports have already been issued, from 1880 to 1883 inclusive.

POPULATION.

TABLE No. 1.

Population of Counties in 1880 *and* 1890.

COUNTIES.	1880.	1890.
Rockingham	49,064	49,650
Strafford	35,558	38,442
Belknap	17,948	20,321
Carroll	18,224	18,124
Merrimack	46,300	49,435
Hillsborough	75,634	93,247
Cheshire	28,734	29,579
Sullivan	18,161	17,304
Grafton	38,788	37,217
Coös	18,580	23,211
Total	346,991	376,530

Table No. 1 shows the population by counties according to the United States census of 1880 and 1890. It is from these tables that our deductions as to the population for each year are arrived at.

TABLE No. 2.

Population of New Hampshire for each Year from 1880 *to* 1893 *inclusive.*

YEARS.	Population.	YEARS.	Population.
1880	346,991	1887	367,728
1881	349,952	1888	370,689
1882	352,913	1889	373,650
1883	355,874	1890	376,530
1884	358,845	1891	379,491
1885	361,806	1892	382,452
1886	364,767	1893	385,413

Table No. 2 represents the population of New Hampshire for each year from 1880 to 1893 inclusive, and is calculated from the census returns of 1880 and 1890. In this table the population for each year except 1880 and 1890 is calculated, and is believed to be approximately correct. The figures in the table mentioned are estimated upon the basis that there has been a steady increase in the population in the same ratio as was shown between the census returns of the two years named.

BIRTHS, MARRIAGES, AND DEATHS.

TABLE No. 3.

Births, Marriages, and Deaths, with the Population and Rates, for 1884 *to* 1893, *inclusive.*

YEARS.	Population.	Births.	Marriages.	Deaths.	Birth-rate per 1,000.	Persons married to 1,000.	Death-rate per 1,000.
1884	358,845	6,247	3,292	6,194	17.40	18.34	17.26
1885	361,806	6,319	3,180	6,201	17.46	17.56	17.13
1886	364,767	6,657	3,324	6,426	18.24	18.22	17.61
1887	367,728	6,910	3,495	6,479	18.78	19.00	17.61
1888	370,689	6,443	3,379	6,854	17.38	18.22	18.48
1889	373,650	6,912	3,621	6,696	18.49	19.36	17.91
1890	376,530	6,946	3,621	7,368	18.44	19.22	19.56
1891	379,491	7,510	3,904	7,310	19.94	20.72	19.41
1892	382,452	7,746	4,074	7,988	20.25	21.30	20.88
1893	385,413	8,348	4,090	7,663	22.17	21.22	20.35

Table No. 3 shows the population, number of births, marriages, deaths, with the birth-rate, marriage-rate, and death-rate to each 1,000 of the population, for the years 1884 to 1893, inclusive. It will be seen by this table that there has in the last two years been an increase in the totals, with the exception of deaths. The number of births reported is greater than for any previous year. This is probably due largely to more complete returns in 1893 than in any previous year.

BIRTHS.

There were returned for the year 1893, 8,348 births, or 620 more than was reported the previous year.

The birth-rate for the state was 22.17 to each 1,000 of the population for the entire state.

TABLE No. 4.

Births in Cities for 1893, *with rate per* 1,000.

CITIES.	Population of 1890.	Births.	Birth-rate per 1,000.
Portsmouth	9,827	175	17.81
Dover	12,790	301	23.53
Concord	17,004	448	26.35
Manchester	44,126	1,150	26.06
Nashua	19,311	698	36.15
Keene	7,446	151	20.28
Rochester	7,396	172	23.26
Laconia	6,143	214	34.83
Somersworth	6,207	208	33.51

Table No. 4 gives the population, number of births, and birth-rate per 1,000 of the population for the several cities of the state. It will be seen by this table that the highest birth-rate is to be credited to Nashua—the rate of 36.15 to each 1,000 of the population. The lowest birth-rate was in Portsmouth with only 17.81 to each 1,000 of the population.

TABLE No. 5.

Percentage of American and Foreign Births, by Counties, 1893.

COUNTIES.	PARENTS.			Births with parentage not stated.
	American born.	Foreign born.	One foreign born.	
Rockingham	62.79	20.00	13.96	29
Strafford	40.18	44.95	13.01	18
Belknap	50.42	29.46	12.46	27
Carroll	68.91	16.03	9.61	17
Merrimack	49.57	34.05	13.66	29
Hillsborough	39.21	42.71	14.22	95
Cheshire	53.53	26.62	15.34	30
Sullivan	62.50	18.27	14.42	15
Grafton	70.28	11.11	13.75	35
Coös	29.76	47.02	18.89	40
Total for state	48.56	33.27	11.76	335

Table No. 5 represents the percentage of parents by nativity. This table shows that less than one half (48.56) of the children born in the state during the year were of American parentage; 33.27 per cent. of the children born in the state in 1893 were of foreign parentage.

This table, in connection with the census statistics of nativity of the population of the state, offers a very interesting and instructive study.

MARRIAGES.

The number of marriages returned for the year 1893 was 4,090, the largest number ever reported in a single year, and 16 larger than was returned the previous year.

TABLE No. 6.

Marriage-rates for 1882 *to* 1893, *inclusive.*

YEARS.	Marriages.	Persons married to 1,000 living.	Number living to one married.
1882	3,433	19.44	103
1883	3,495	19.68	102
1884	3,292	18.34	109
1885	3,180	17.56	114
1886	3,324	18.22	109
1887	3,495	19.00	105
1888	3,379	18.22	109
1889	3,621	19.36	103
1890	3,621	19.22	103
1891	3,904	20.72	97
1892	4,074	21.30	93
1893	4,090	21.22	94
Average	3,575	18.35	103

Table No. 6 shows the total number of marriages from 1882 to 1893, inclusive; also the percentage of persons married to each 1,000 of the living population, together with the number living to each marriage.

The average number of marriages for the past eleven years is 3,575 annually.

TABLE No. 7.

Marriages for eleven years, 1883 to 1893, inclusive, by Ages.

SEX.	Under 20.	20 to 25.	25 to 30.	30 to 35.	35 to 40.	40 to 45.	45 to 50.	50 to 55.	55 to 60.	60 to 70.	70 to 80.	Over 80.	Not stated.
Males....	1,876	14,705	10,408	4,643	2,432	1,426	981	750	535	755	265	19	674
Females.	10,625	14,810	6,419	2,720	1,572	935	636	422	238	261	41	1	794

TABLE No. 8.

Marriages according to Nativity.—Percentages 1882 to 1892, inclusive.

YEARS.	Both Americans.	Both foreign.	Groom American.	Bride American.	Not stated.
1882	65.74	12.09	5.13	4.14	12.90
1883	66.15	12.62	5.38	4.18	11.67
1884	69.44	12.91	5.32	3.92	8.41
1885	69.75	11.57	4.97	4.84	8.87
1886	67.87	13.39	6.50	5.08	7.16
1887	65.72	15.79	6.07	5.49	6.93
1888	64.22	17.16	7.10	6.31	5.21
1889	64.32	17.04	7.40	6.55	4.69
1890	62.19	18.58	7.53	7.15	4.53
1891	62.45	18.49	7.38	6.74	4.94
1892	59.82	21.01	7.81	6.82	4 54
1893	60.88	18.80	10.68	8.09	1.54

TABLE No. 9.

Proportion of American to Foreign Born Persons Married, for 1882 *to* 1893, *inclusive.*

YEARS.	American-born.	Foreign-born.
1882	80.80	19.20
1883	80.30	19.70
1884	80.86	19.14
1885	81.92	18.08
1886	79.34	20.66
1887	76.82	23.18
1888	74.82	25.18
1889	74.80	25.20
1890	65.14	34.86
1891	73.12	26.87
1892	70.33	29.67
1893	71.37	28.63

Table No. 9 represents the proportion of American to foreign-born persons married from 1882 to 1893, inclusive.

This table is exceedingly instructive from the fact that it shows a progressive diminution in the number of children born of American parents, with an increase of children of foreign parentage.

By referring to table No. 5 it will be seen that, although 71.37 per cent. of the marriages were among American-born, only 48.56 per cent. of the children born for the year were of American parentage. On the other hand, 28.63 per cent. of the marriages were among foreign-born, with a birth record of 33.27 per cent. of children of foreign parentage.

In Strafford, Hillsborough, and Coös counties, the number of children of foreign parents was greater for the year 1893 than the number of American-born.

DIVORCES.

TABLE No. 10.

Ratio of Divorces to Marriages from 1882 to 1893, inclusive.

YEARS.	Number of marriages.	Marriage-rate per 1,000.	Number of divorces.	Ratio of divorces to marriages.
1882.....	3,433	19.44	314	1 to 10.93
1883.....	3,495	19.68	273	1 to 12.80
1884.....	3,292	18.34	315	1 to 10.45
1885.....	3,180	17.56	291	1 to 10.92
1886.....	3,324	18.22	382	1 to 8.70
1887.....	3,495	19.00	325	1 to 10.75
1888.....	3,379	18.22	386	1 to 8.75
1889.....	3,621	19.22	368	1 to 9.83
1890.....	3,621	19.22	382	1 to 9.48
1891.....	3,904	20.72	412	1 to 10.55
1892.....	4,074	21.30	347	1 to 11.74
1893.....	4,090	21.22	398	1 to 10.27

Table No. 10 shows the total number of divorces decreed from 1882 to 1893, inclusive, by counties, also the ratio of divorces to marriages for the same period. In the year 1893 one divorce was decreed to each 10.27 marriages, this being a slight decrease over the ratio of the two years previous. As a whole there has not been any very marked variation of ratios for the past eleven years.

Additional tables relating to the alleged causes of divorce for the year 1893, and also for the period of 11 years, may be found in the registration report.

DEATHS.

The number of deaths returned for the year 1893 was 7,663, 325 less than was returned the previous year.

The death-rate per 1,000 of the population for the year is 20.35.

TABLE No. 11.

Deaths and Death-rates from 1884 *to* 1893, *inclusive.*

YEARS.	Deaths registered.	Deaths to 1,000 of population.*	Population.*
1884	1,694	16.26	358,845
1885	6,201	17.13	361,806
1886	6,426	17.61	364,767
1887	6,479	17.61	367,728
1888	6,854	18.48	370,689
1889	6,696	17.91	373,650
1890	7,368	19.56	376,530
1891	7,310	19.41	379,491
1892	7,988	20.88	382,452
1893	7,663	20.35	385,413
Average	6,918	18.52	.....

*Population estimated for all but census years.

Table 11 represents the total number of deaths registered each year from 1884 to 1893, inclusive, with the percentage for each year to each 1,000 of the population. This table is liable to give an erroneous impression if it is not borne in mind that the progressive increase in the percentage column is due rather to a more accurate and complete registration from year to year than to any other cause. In the earlier years represented in the table the registration of deaths was not so complete as it is now.

TABLE No. 12.

Mortality of Males and Females compared, 1884 to 1893, inclusive.

YEARS.	Male decedents.	Female decedents.	Male decedents to 100 female decedents.	Death-rate of males to 1,000 male population.	Death-rate of females to 1,000 of female population.
1884.....	3,034	3,122	97.18	17.79	17.69
1885.....	2,948	3,194	92.29	17.28	18.09
1886.....	3,155	3,212	98.20	18.50	18.20
1887.....	3,174	3,267	97.15	18.61	18.51
1888.....	3,419	3,382	101.09	20.04	19.16
1889.....	3,253	3,389	95.98	19.07	19.20
1890.....	3,692	3,624	101.87	21.65	20.53
1891.....	3,557	3,453	103.01	19.60	17.65
1892.....	3,981	3,990	99.77	21.33	21.00
1893.....	2,827	3,812	99.61	20.51	20.42
Average.....	3,404	3,444	98.61	19.44	19.04

Table No. 12 exhibits the mortality of males and females compared for the years 1884 to 1893, inclusive. It will be seen by this table that the mortality among the females was slightly greater than among the males, the percentage for the period given of the male decedence to each 100 females being 98.61; and for the year 1893, 99.61.

The death-rate of the males to each 1,000 of the male population for the 10 years given in the table was 19.44.

The death rate of females to each 1,000 of the female population for the same period was 19.04.

TABLE No. 13.

*Deaths at Age Periods, by Percentages, from 1883 to 1893, inclusive.**

YEARS.	Under 1.	1 to 5.	5 to 10.	10 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	Over 60.
1883.....	14.33	7.58	2.56	5.55	8.58	6.73	6.22	7.64	37.93
1884.....	16.22	7.36	2.61	5.30	7.93	6.26	6.33	7 75	38.38
1885.....	15.98	7.14	2.11	4.42	7.50	6.71	6.71	7.76	40.09
1886.....	16.89	7.70	2.86	4.82	7.73	6.55	6.12	7.47	38.86
1887.....	17.64	7.26	2.05	4.89	6.96	6.25	6.56	7.72	39.70
1888.....	19.23	7.63	2.04	4.93	7.07	6.00	5.53	7.57	38.72
1889.....	19.44	7.71	2.66	4.64	6.56	6.15	5.93	7.63	38.40
1890.....	16.23	6.67	1.99	4.28	7.04	7.42	6.62	9.17	40.49
1891.....	18.30	7.08	2.55	4.40	6.95	6.01	6.29	8.15	40.25
1892.....	16.17	6.64	2.18	4.39	6.70	6.63	6.60	8.76	41.77
1893.....	17.83	7.13	1.93	4.32	7.20	6.62	6.94	8.10	39.86

* Not including those with age not stated, premature and still births.

Table No. 13, is interesting in showing how uniformly the mortality by age periods occurs, even when distributed over a series of years.

TABLE No. 14.

*Deaths at Different Periods, compared with the number Living at the Same Period, 1893.**

	1893.	Persons living at same ages, census of 1890.	Death-rate per 1,000.
Under 1 year	1,296	6,141	211.94
Under 5 years	1,812	30,573	59.26
Twenty to thirty years	521	63,252	8.24
All others	5,025	253,166	19.85
All ages	7,358	376,530†	19.54

* Excluding still births and premature births. † Census of 1890.

Table No. 14 shows the number of deaths at different age periods compared with the number of living at the same period, for 1893. It shows the death-rate per one thousand of the population under one year of age to the living persons of the same age period to be 211.04 as against 199.47 for the previous year, showing a slight increase. Under 5 years of age, 59.26 as against 56.47 for the previous year; between 20 and 30, 8.24 as against 7.99 for 1892. All others 19.85 in 1893 as against 21.59 in 1892. For all ages the rate was 19.54 in 1893 as against 20.44 in the preceding year.

TABLE No. 15.

*Deaths of Children under Five Years of Age, by Seasons, 1893.**

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Months	109	104	119	131	126	98	229	301	247	129	95	115
Quarters		332			355			777			339	
Percentages		18.41			19.69			43.10			18.80	
Half-years			687						1,116			
Percentages			38.10						61.90			
Total deaths					1,803							

* Not including deaths with month not stated, premature and still births.

Table No. 15 represents the mortality of children under 5 years of age, by seasons, for the year 1892. The highest mortality was in the quarter including July, August, and September, and was 43.10 per cent. as against 37.66 for the previous year. The next highest rate was in the second quarter of the year, at 19.69, followed by the fourth quarter, at 18.80, and the first quarter at 18.41.

The total mortality by half years was as follows:

First half of the year, 687.
Last half of the year, 1,116.

TABLE No. 16.

Total Deaths by Seasons, 1893.*

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Months.....	584	571	571	638	646	496	684	718	627	551	515	736
Quarters.....		1,726			1,780			2,029			1,802	
Percentages..		23.53			24.26			27.65			24.56	
Half-years....			3,506						3,831			
Percentages..			47.79						52.21			
Total deaths..						7,337						

* Not including deaths with month not stated, premature and still births.

Table No. 16 gives the total number of deaths of all ages by seasons for the year 1893. There was a total of 7,337 deaths as against 7,682 for the previous year.

By quarters the death-rate was the heaviest in the third quarter of the year, which rate is augmented by a large death-rate from intestinal diseases among children. For the other quarters of the year the mortality variation is exceedingly small.

TABLE No. 17.

Mortality from Prominent Zymotic Diseases from 1884 *to* 1893, *inclusive.*

YEARS.	DISEASES.												
	Cholera infantum.	Croup.	Diarrhœa.	Diptheria.	Dysentery.	Erysipelas.	Fever, cerebro-spinal.	Fever, Typhoid.*	Measles.	Pertussis.	Scarlatina.	Septicæmia.	Total.
1884.....	266	49	53	110	80	19	25	137	3	14	52	27	835
1885.....	219	74	59	78	40	25	20	136	45	25	53	38	812
1886.....	362	64	38	156	79	18	26	194	18	26	21	27	1,029
1887.....	336	84	38	177	53	20	34	134	39	21	26	30	992
1888.....	370	94	50	103	63	36	34	150	55	23	34	29	1,041
1889.....	353	88	68	210	67	27	25	161	16	47	18	29	1,109
1890.....	399	64	50	164	48	29	....	143	9	26	16	57	1,005
1891.....	486	56	46	160	51	43	....	170	19	27	13	38	1,109
1892.....	366	45	53	134	42	39	19	109	24	37	27	47	942
1893.....	423	36	50	63	63	29	3	121	32	23	52	43	938
Average	358	65	51	136	59	29	15	145	26	27	31	36	981

* Including fever, bilious, intermittent, malarial, and typho-malarial fevers.

TableNo. 17 shows the mortality from the more prominent zymotic diseases from 1884 to 1893, inclusive. The total number of deaths coming under this class for the year 1893 is 938—practically the same as the preceding year. The largest number of deaths in this table are from cholera infantum, to wit: 423 for the entire state, which, with the exception of the year 1891, is the largest number of deaths ever returned from this cause.

Croup is responsible for 36 deaths, a figure lower than was ever before returned.

Diarrhœa is charged with 50 deaths, the average for the ten years included in the table being 51.

Diphtheria, with only 63 deaths for the year, is a record far below that heretofore recorded in any one year, and is less than one half the number reported for the previous year. The average death-rate for the ten years referred to is 136.

Dysentery is responsible for 63 deaths in 1893.

Erysipelas 29 deaths, which is the exact average for the entire period covered by the table.

Cerebro-spinal fever is chargeable with only three deaths far 1893 as against 19 the previous year.

There were 121 deaths returned from typhoid fever,—a slight increase over the preceding year, but considerably lower than the average for the ten years.

Measles caused 32 deaths as against 24 the preceding year, with an average of 26 for ten years.

Whooping cough caused 23 deaths in 1893, the average given in the table being 27.

Scarlet fever was responsible for 52 deaths in 1893 as against 27 the preceding year, and is a larger number than has been reported since 1885. The average annual mortality from this disease for the ten years included in the table is 31.

Septicæmia was the cause of 43 deaths in 1893 as against 47 the previous year.

TABLE 18.

Mortality from Principal Constitutional Diseases from 1884 *to* 1893, *inclusive.*

YEARS.	DISEASES.										
	Dropsy.	Anæmia.	Cancer.	Mortification.	Rheumatism.	Scrofula.	Tabes mesenterica.	Phthisis (pulmonary).	Hydrocephalus.	Tubercular meningitis.	Total.
1884	80	43	213	18	26	26	4	865	27	*	1,302
1885	90	32	212	24	28	22	2	857	25	*	1,292
1886	83	28	206	27	47	16	11	809	33	19	1,279
1887	79	17	218	29	47	16	7	766	23	16	1,218
1888	75	34	203	22	43	21	14	742	30	13	1,197
1889	62	40	213	21	43	22	13	651	21	24	1,110
1890	53	28	276	33	30	15	6	825	13	30	1,309
1891	41	41	213	2	24	11	19	695	22	15	1,083
1892	43	35	235	24	25	17	10	736	16	24	1,165
1893	49	26	283	30	27	14	21	737	23	27	1,237
Average	65	32	227	23	34	18	11	768	23	17	1,219

* Not classed separately.

Table No. 18 shows the mortality from the principal constitutional diseases for the ten years included in the table.

Phthisis (which no longer belongs under this classification) was responsible for 737 deaths in 1893—one more than was returned in 1892, as against an average of 768 for the period covered by the table.

There were 283 deaths chargeable to cancer in 1893 as against 235 for the previous year. It will be noticed that there is a remarkable uniformity in the number of deaths from cancer

from year to year, although the return for 1893 is the highest yet recorded.

TABLE NO. 19.

Mortality from Principal Local Diseases from 1884 *to* 1893, *inclusive.*

YEARS.	DISEASES.													
	Apoplexy.	Paralysis.	Convulsions.	Cephalitis.*	Brain disease.	Heart disease.	Bronchitis.	Pneumonia.	Enteritis.	Gastritis.	Peritonitis.	Liver disease.	Bright's disease, nephritis and other kidney diseases.	Total.
1884.....	192	248	99	120	134	507	78	436	69	44	61	63	140	2,191
1885.....	206	278	93	153	122	489	112	504	57	49	44	63	157	2,307
1886.....	220	249	71	141	127	510	81	466	53	66	48	71	143	2,246
1887.....	210	253	64	117	121	552	114	556	57	54	48	69	163	2,384
1888.....	243	273	88	143	112	575	142	628	39	51	63	72	154	2,634
1889.....	259	196	76	151	126	564	127	582	56	42	57	56	200	2,492
1890.....	263	251	65	186	140	568	194	703	63	60	51	56	201	2,801
1891.....	283	241	78	161	130	572	180	673	73	47	68	55	182	2,743
1892.....	308	309	78	188	140	571	217	890	72	68	94	48	222	3,105
1893.....	331	239	76	208	122	605	191	685	76	56	78	65	194	2,926
Average.. .	251	244	79	155	127	551	144	612	62	54	61	62	176	2,583

* Meningitis and cerebritis included.

Table No. 19 gives the mortality of the principal local diseases from 1884 to 1893, inclusive. The total number of deaths returned under this classification in 1893 was 2,926 as against 3,105 for the previous year.

The chief cause of mortality in these tables is pneumonia, which is chargeable with 685 deaths in 1893 as against 890 for the previous year. This return shows a large falling off

over the death-rate of 1892; but the rate is still a little higher than the average for ten years.

Heart disease shows 605 deaths in 1893 as against 571 for the previous year.

Apoplexy shows 331 deaths in 1893 as against 308 in 1892. The average number of deaths from this cause for ten years is 251.

Bright's disease caused 194 deaths in 1893 as against 222 the previous year.

TABLE No. 20.

Mortality from Principal Developmental Diseases from 1884 *to* 1893, *inclusive.*

YEARS.	DISEASES.									
	Still-born.	Debility, infantile.	Debility, premature birth.	Malformation.	Teething.	Innutrition.	Childbirth.	Old age.	Atrophy and debility.	Total.
1884.....	156	*	35	13	19	*	27	457	144	851
1885.....	145	*	39	13	13	*	31	420	167	828
1886.....	140	68	54	12	16	50	30	468	98	936
1887.....	166	56	63	10	20	76	27	449	78	945
1888.....	189	91	69	19	20	81	20	407	112	1,008
1889.....	220	79	68	24	18	63	27	426	104	1,029
1890.....	197	113	65	11	15	95	28	410	204	1,138
1891.....	213	104	73	18	14	90	23	385	208	1,128
1892.....	205	101	82	21	11	81	19	441	75	1,036
1893.....	203	90	102	12	12	100	22	402	94	1,037
Average...	183	70	65	15	16	64	25	426	128	994

* Classed with atrophy and debility.

Table No. 20 shows the number of decedents from the principal developmental diseases for the ten years given.

TABLE No. 21.

Mortality from Twenty Prominent Causes from 1884 *to* 1893, *inclusive.*

CAUSES OF DEATH.	Deaths in 1893.	ORDER OF FATALITY.									
		1893	1892	1891	1890	1889	1888	1887	1886	1885	1884
Consumption	737	1	2	1	1	1	1	1	1	1	1
Pneumonia	685	2	1	2	2	2	2	3	5	2	5
Heart disease	605	3	3	3	3	3	3	2	2	4	2
Apoplexy and paralysis	570	4	4	4	4	4	4	4	3	3	4
Old age	402	6	5	6	5	5	5	5	4	5	3
Cholera infantum	423	5	6	5	6	6	6	6	6	6	6
Cancer	283	8	8	8	7	7	7	7	7	7	7
Diphtheria	63	20	13	13	12	8	15	9	10	18	13
Accident and negligence	292	7	9	7	8	9	8	8	9	8	11
Typhoid fever*	121	13	15	11	13	10	9	10	8	9	10
Cephalitis†	208	9	11	12	11	11	10	12	11	10	12
Diarrhea and dysentery	113	14	17	18	17	12	12	14	13	15	9
Bright's disease	123	11	12	14	16	13	20	15	15	14	14
Bronchitis	191	10	10	10	10	14	11	13	17	12	17
Brain disease	122	12	14	16	14	15	13	11	12	11	8
Atrophy and debility	94	16	20	9	9	16	14	18	14	13	18
Croup	36	21	21	21	21	17	16	16	21	19	22
Debility, infantile	90	18	16	17	15	18	17	23	22	‡	....
Convulsions	76	19	19	20	20	19	18	21	19	16	15
Innutrition	100	15	18	19	18	20	19	19	23	‡	....
Influenza	91	17	7	15	19	....	....	....	....	....	....

* Fever, bilious fever, malarial, intermittent, and typho-malarial fevers included
† Meningitis and cerebritis included. ‡ Classed with atrophy and debility.

Table No. 21 and diagram No. 1 show the mortality from twenty of the most prominent causes of death from 1884 to 1893 inclusive. In these tables consumption stands at the head, as it always has, with the single exception of 1892, when pneumonia ranked first.

Consumption is responsible for 737 deaths in 1893, while the average for ten years has 768 deaths. The table alluded to shows the order of fatality from the diseases given for the period named. A further consideration of some of these diseases will be found in the following tables.

DIAGRAM NO. 1.—SHOWING THE COMPARATIVE MORTALITY, BY ABSOLUTE NUMBER OF DECEDENTS FROM TWENTY PROMINENT CAUSES OF DEATH DURING YEAR ENDING DECEMBER 31, 1893.

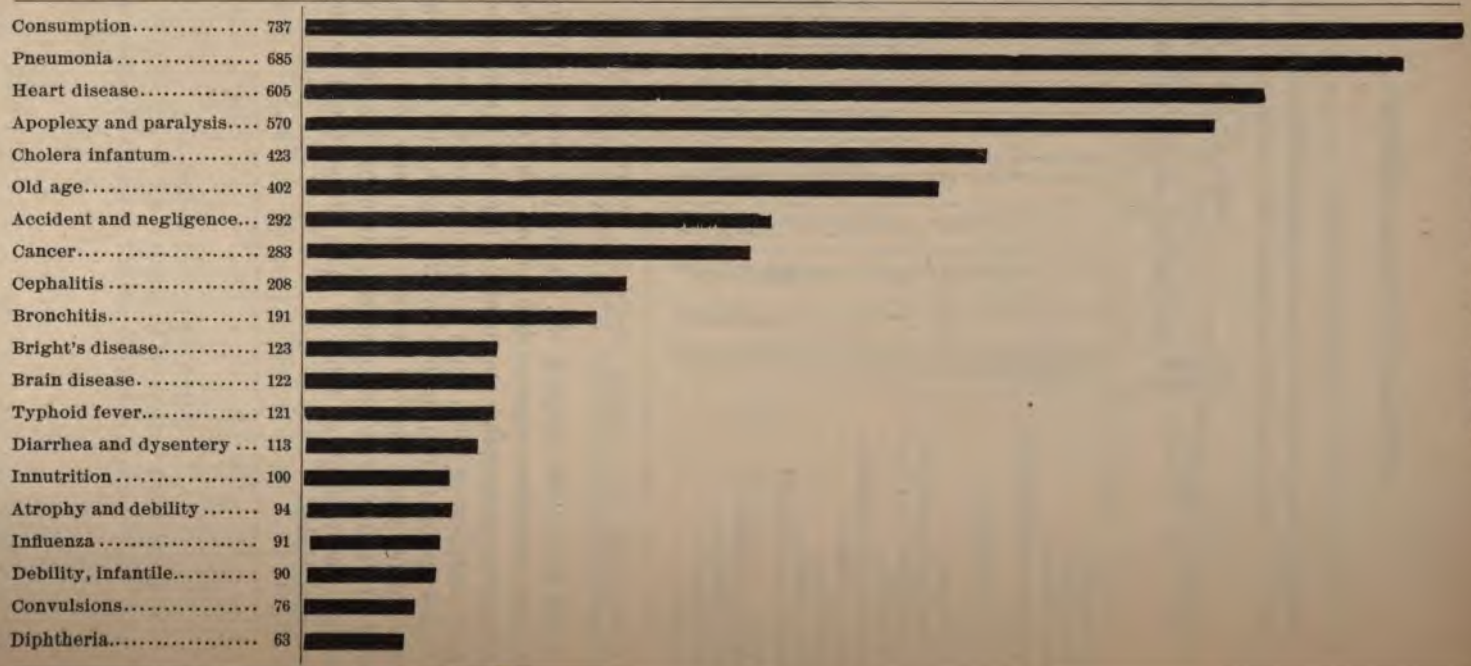


TABLE No. 22.

Mortality from Consumption from 1884 to 1893, inclusive.

YEARS.	Deaths.	Percentages of deaths to deaths from all causes.	Death-rate per 10,000 living population.
1884	865	14.01	24.18
1885	857	13.82	23.68
1886	809	12.58	22.17
1887	766	11.82	20.82
1888	742	10.82	20.01
1889	651	9.72	17.42
1890	825	11.19	21.91
1891	695	9.51	18.31
1892	736	9.21	19.24
1893	737	9.62	19.13

Table No. 22 shows the mortality from consumption, the percentages of deaths to deaths from all causes, and the death-rate for every 10,000 of the living population from 1884 to 1893 inclusive.

TABLE No. 23.

Deaths from Pulmonary Consumption, by Seasons, Ages, and Nativity, 1893, for the City of Manchester.

Months	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.	American.	Foreign.	Not stated.
	11	5	11	8	5	7	12	3	6	8	8	7				
Quarters	27			20			21			23			91			
Ages	Under 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Not stated.					
	9	3	8	27	21	10	6	6			1					
Nativity	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	48	41	2
Males	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	43	..	..	..
Females	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	48	..	..	..

Table No. 23 gives the deaths from consumption by season, age, and nativity, in the city of Manchester for 1893. Total number of deaths from this cause was 91, exactly the same as was reported the previous year. Of the decedents, 43 were males, amd 48 females; 48 were American born, 41 foreign born, and 2 nativity not stated. The fatality by months was as follows: 7 in June and December; July, 12; January and March, 11 each; April, October, and November, 8 each; September, 6; February and May, 5 each; August, 3.

Twenty-seven were between 20 and 30 years of age; 21, between 30 and 40; 10 between 40 and 50; 9 under 10 years of age; 8 between 15 and 20; 6 between 50 and 60; 6 between 60 and 70; 3 between 10 and 15; and 1, age not stated.

TABLE No. 24.

Deaths from Pulmonary Consumption by Seasons, Ages, and Nativity, 1893, for the City of Concord.

Months	January. 5	February. 1	March. 3	April. 5	May. 4	June. 4	July. 1	August. 7	September. 3	October. 3	November. 3	December. 1	Total.	American.	Foreign.	Not stated.
Quarters	9			13			11			7			40			
Ages	Under 10. 1	10 to 15. 1	15 to 20. 2	20 to 30. 16	30 to 40. 7	40 to 50. 5	50 to 60. 4	60 to 70. 3	70 to 80. 1	Over 80.	Not stated.					
Nativity	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	31	9	..
Males	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14	..	..	..
Females	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26	..	..	..

Table No. 24 is a record of consumption in the city of Concord for the year 1893. There was a total of 40 deaths from this disease, 14 males and 26 females; 31 were American born, and 9 foreign born.

Seven died in August; 5 in January and April; 4 in May and June; 3 in March, September, October, and November; 1 in February, July, and December.

Of the ages, 16 were between 20 and 30; 7 between 30 and 40; 5 between 40 and 50; 4 between 50 and 60; 3 between 60 and 70; 1 under 10; 1 between 10 and 15; and 1 between 70 and 80.

TABLE No. 25.

Deaths from Pulmonary Consumption, by Seasons, Ages, and Nativity, 1893, for the City of Nashua.

Months	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.	American.	Foreign.	Not stated.
	3	1	1	1	3	1	5	1	4	1	4	5				
Quarters	5			5			10			10			30			
Ages	Under 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Not stated.					
	3		3	11	5	2	3		1	1	1					
Nativity	.....			.....			.....			.....			....	12	12	6
Males	.....			.....			.....			.....			16	..	..	..
Females	.....			.....			.....			.....			14	..	..	..

Table No. 25 represents the mortality from consumption in Nashua for 1893, the total number being 30, 16 males and 14 females. Twelve were American born, 12 foreign born, and 6 nativity not stated.

There were 5 deaths in July and December; 4 in September and November; 3 in January and May; and 1 in February, March, April, June, August, and October.

Eleven of the decedents were between 20 and 30; 5 between 30 and 40; 3 under 10; 3 between 15 and 20; 3 between 50 and 60; 2 between 40 and 50; 1 between 70 and 80; 1 over 80, and 1 age not stated.

TABLE No. 26.

Deaths from Pulmonary Consumption, by Seasons, Ages, and Nativity, 1893, for the City of Portsmouth.

Months	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.	American.	Foreign.	Not stated.
	1	2	1	2	2	3	5	1	2		1	4				
Quarters		4			7			8			5		24			
Ages	Under 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Not stated.					
	1		3	4	6	5	2	2	1							
Nativity													....	17	6	1
Males													17	..	..	..
Females													7	..	..	..

In Portsmouth the deaths from consumption for 1893 are represented in table No. 26. There was a total of 24 deaths, 17 males and 7 females. Seventeen were American born, 6 foreign born, and 1 nativity not stated.

Five died in July; 4 in December; 3 in June; 2 in February, April, May, and September; 1 in January, March, August, and November.

Six decedents were between 30 and 40 years of age; 5 between 40 and 50; 4 between 20 and 30; 3 between 15 and 20; 2 between 50 and 60; 2 between 60 and 70; 1 under 10; 1 between 70 and 80.

TABLE No. 27.

Deaths from Pulmonary Consumption, by Seasons, Ages, and Nativity, 1893, for the City of Dover.

Months	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.	American.	Foreign.	Not stated.
	1	5	6	3	4	2	2	3	5	3	5	4				
Quarters	12			9			10			12			43			
Ages	Under 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Not stated.					
	2		5	16	11	4	4	1								
Nativity														32	9	2
Males													21			
Females													22			

Table No. 27 shows the deaths from consumption in Dover for the year 1893, there being a total of 43, 21 males and 22 females. Of the decedents 32 were American born, 9 foreign born, and 2 nativity not stated.

Six died in March; 5 in February, September, and November; 4 in May and December; 3 in April, August, and October; 2 in June and July; 1 in January.

Sixteen were between 20 and 30 years of age; 11 between 30 and 40; 5 between 15 and 20; 4 between 40 and 50; 4 between 50 and 60; 2 under 10; 1 between 60 and 70.

TABLE No. 28.

Deaths from Pulmonary Consumption, by Seasons, Ages, and Nativity, 1893, for the City of Keene.

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TABLE No. 29.

Deaths from Pulmonary Consumption, by Seasons, Ages, and Nativity, 1893, for the City of Rochester.

Months	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.	American.	Foreign.	Not stated.
	2				1		1		1	1						
Quarters	2			1			2			1			6			
Ages	Under 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Not stated.					
				3	1		1	1								
Nativity														5	1	
Males													4			
Females													2			

Table No. 29 represents the deaths from consumption in Rochester for the year 1893, the total being 6, 4 males and 2 females. Five were American born, 1 foreign born.

Two died in January; 1 in May, July, September, and October.

Three of the decedents were between 20 and 30; 1 between 30 and 40; 1 between 50 and 60; 1 between 60 and 70.

TABLE No. 30.

Deaths from Pulmonary Consumption, by Seasons, Ages, and Nativity, 1893, for the City of Laconia.

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TABLE No. 31.

Deaths from Pulmonary Consumption, by Seasons, Ages, and Nativity 1893, for the City of Somersworth.

Months	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.	American.	Foreign.	Not stated.
		1	3		1			3	1	2	1	2				
Quarters		4			1			4			5		14			
Ages	Under 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Not stated.					
	3	2	1	2	2	1	1	1	1							
Nativity														7	7	
Males													6			
Females													8			

Table No. 31 shows the deaths from consumption in 1893 for Somersworth, a total of 14—6 males and 8 females. Seven American born and 7 foreign born.

Three died in March; 3 in August; 2 in October; 2 in December; 1 in February, May, September, and November.

Three were under 10 years of age; 2 between 10 and 15; 2 between 20 and 30; 2 between 30 and 40; 1 between 15 and 20; 1 between 40 and 50; 1 between 50 and 60; 1 between 60 and 70; 1 between 70 and 80.

PNEUMONIA.

TABLE No. 32.

Mortality from Pneumonia, by Counties, from 1884 to 1893, inclusive.

COUNTIES.	YEARS.										Average.
	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893	
Rockingham	45	63	77	70	83	66	90	77	96	88	76
Strafford	39	48	37	46	52	38	80	73	96	65	57
Belknap	18	24	25	44	50	37	42	28	55	31	35
Carroll	30	27	15	33	46	49	37	42	50	19	34
Merrimack	50	72	60	85	73	86	94	73	137	95	82
Hillsborough	110	128	112	128	129	131	158	185	175	159	141
Cheshire	36	52	39	55	55	52	44	54	86	64	54
Sullivan	21	22	23	22	30	31	32	31	62	45	32
Grafton	66	48	54	52	77	64	74	53	84	71	64
Coös	21	20	24	21	33	26	52	57	49	48	35
Total	436	504	466	556	628	582	703	673	890	685	612

Table No. 32 gives the mortality from pneumonia, by counties, from 1884 to 1893, inclusive, with the averages for the entire period. The total number of deaths from this disease in 1893 was 685, which is 205 less than was returned the previous year, but which number is still higher than the average for the period covered by the entire table. The influence of influenza was responsible for the high rate of mortality from pneumonia in 1892, and probably accounts for the relatively high death-rate from this disease since 1889.

TABLE No. 33.

Mortality from Pneumonia by Months and Quarters, from 1884 *to* 1893, *inclusive.*

YEARS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Not stated.
1884	55	55	51	52	32	13	14	11	5	28	51	67	2
1885	53	59	101	95	35	25	13	10	10	33	38	32	...
1886	32	44	73	51	51	33	22	18	18	24	46	54	...
1887	71	73	85	85	49	17	13	13	14	34	47	54	1
1888	72	95	75	73	76	24	16	23	21	43	36	72	2
1889	69	66	79	102	51	22	15	19	16	53	41	49	...
1890	213	74	69	43	47	35	18	9	23	23	69	79	1
1891	73	60	82	72	95	41	13	7	14	23	37	152	4
1892	384	110	83	86	57	21	5	11	19	21	34	54	5
1893	75	71	95	87	67	38	18	14	14	24	48	133	1
Total	1,097	707	793	746	560	269	147	135	154	306	447	756	
	2,587			1,575			436			1,499			

Table 33 gives the mortality from pneumonia, by months and quarters, for the ten years covered by the table. The largest mortality for the year 1893 was in December, it being considerably more than double the death-rate from the same disease in the preceding December. The effect of influenza upon the mortality of this disease is apparent in the study of the death-rate by months as exhibited in the above table.

BRAIN DISEASES.

TABLE No. 34.

Mortality from Brain Diseases from 1884 *to* 1893, *inclusive.*

YEARS.	DISEASES.						
	Cephalitis.*	Apoplexy.	Paralysis.	Insanity.	Convulsions.	Brain diseases.	Total.
1884	120	192	248	22	99	134	815
1885	133	206	278	27	93	122	859
1886	141	220	249	24	71	127	832
1887	117	210	253	25	64	121	790
1888	143	243	273	37	88	112	896
1889	151	259	196	35	76	126	843
1890	186	263	251	28	65	140	933
1891	161	283	241	44	78	130	917
1892	173	308	209	33	78	140	941
1893	208	331	239	26	76	122	1,002
Average	153	251	244	30	79	127	883

* Meningitis and Cerebritis included.

Table No. 34 shows the mortality from brain diseases from 1884 to 1893, inclusive. There is an increased mortality from certain diseases of the brain, notably in cephalitis, under which are classed the inflammatory diseases of the brain. Apoplexy exhibits a higher death-rate than heretofore. The total number of deaths chargeable to brain diseases for the year 1893 is 1,002, the highest number returned for the years embraced in the table.

DIARRHŒAL DISEASES.

TABLE No. 35.

Mortality from Diarrhœal Diseases from 1884 *to* 1893, *inclusive.*

YEARS.	DISEASES.					Total of diarrhœal diseases.
	Cholera infantum.	Cholera morbus.	Diarrhœa.	Dysentery.	Enteritis.	
1884	266	21	52	80	69	488
1885	219	20	40	40	57	376
1886	362	14	38	79	53	546
1887	336	16	38	53	57	500
1888	370	8	50	63	39	530
1889	353	12	68	67	56	556
1890	399	12	.....	50	63	524
1891	486	16	46	51	73	672
1892	366	17	53	42	72	550
1893	423	20	50	63	76	632
Average	358	16	43	59	61	574

Table No. 35 gives the mortality from diarrhœal diseases for the past ten years. Cholera infantum, which is responsible for the largest number of deaths in this group, shows a higher mortality than for the previous year, and considerably higher than the average for the ten years included in the table. The total number of deaths under this class for the year is 632, the average for the ten years being 574.

CHOLERA INFANTUM.

TABLE No. 36.

Mortality from Cholera Infantum from 1884 *to* 1893, *inclusive.*

YEARS.	Deaths.	Percentages of deaths to deaths from all causes.	Death-rates per 10,000 living (estimated population.)
1884	266	4.29	7.41
1885	219	3.53	6.05
1886	362	5.63	9.92
1887	336	5.18	9.13
1888	370	5.39	9.98
1889	353	5.27	9.44
1890	399	5.41	10.59
1891	486	6.64	12.08
1892	366	4.58	9.57
1893	423	5.52	10.97
Average	358	5.14	9.51

In Table No. 36 is exhibited the mortality from cholera infantum for ten years, together with percentages of deaths from this disease to the total number of deaths, and also its death-rate per 10,000 of the living population. The average number of deaths from cholera infantum during this ten year period is 358 annually, while for the year 1893 it was 423, a figure which has been exceeded only once during the period embraced in the table.

TABLE No. 37.

Mortality from Cholera Infantum, by ages, from 1884 *to* 1893, *inclusive.*

YEARS.	Under 1.	1 to 5.	5 to 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Unknown.	Total.
1884.....	214	48	....	....	....	....	1	....	1	....	....	..	2	266
1885.....	186	33	....	....	....	....	....	....	....	....	....	..	..	219
1886.....	283	77	2	....	....	....	....	....	....	....	....	..	..	362
1887.....	284	51	....	....	....	....	....	....	....	....	....	..	1	336
1888.....	298	70	....	....	....	....	....	....	....	....	....	..	2	370
1889.....	297	54	1	....	....	....	....	....	....	....	....	..	1	353
1890.....	343	52	4	....	....	....	....	....	....	....	....	..	..	399
1891.....	409	74	3	....	....	....	...	....	....	....	....	..	..	486
1892.....	320	41	4	1	....	....	....	....	....	....	....	..	..	366
1893.....	369	52	2	....	....	....	....	....	....	....	....	..	..	423

The above table shows the mortality from cholera infantum by years and age periods from 1884 to 1893 inclusive. It will be seen by this table that cholera infantum is almost wholly a disease of early infancy, the majority of deaths occurring from it being in children under one year of age.

CANCER.

TABLE No. 38.

Mortality from Cancer, with rates to estimated Population and to Total Mortality from 1884 *to* 1893, *inclusive.*

YEARS.	Deaths.	Death-rates per 10,000 of estimated population.	Ratio to total mortality per 1,000.
1884	213	5.93	34.39
1885	212	5.85	34.19
1886	206	5.64	32.06
1887	218	5.92	33.65
1888	203	5.47	29.62
1889	213	5.70	31.81
1890	276	7.33	37.45
1891	213	5.61	30.32
1892	235	6.14	29.41
1893	283	7.34	30.67

Table No. 38 gives the mortality from cancer from 1884 to 1893 inclusive, with ratios to the total mortality and to the estimated population. This table is striking in the uniformity of the mortality from this disease from year to year.

DIPHTHERIA.

TABLE No. 39.

Mortality from Diphtheria from 1884 to 1893, inclusive, by ages.

YEARS.	Under 1.	1 to 5.	5 to 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Unknown.	Total.
1884.....	8	39	34	17	4	2	....	1	3	....	....	1	1	110
1885.....	10	32	22	5	3	4	....	1	1	....	....	..	..	78
1886.....	9	53	58	22	7	3	1	1	2	....	....	..	..	156
1887.....	7	74	51	20	6	9	4	2	1	1	1	..	1	177
1888.....	6	43	36	7	4	2	1	1	2	1	....	..	..	103
1889.....	7	86	68	18	13	10	3	3	....	1	....	..	1	210
1890.....	6	64	45	26	10	3	4	3	....	....	....	1	2	164
1891.....	5	74	48	17	7	2	4	....	....	1	....	..	2	160
1892.....	9	54	37	14	5	6	2	2	....	2	....	..	3	134
1893.....	6	23	19	9	1	3	1	1	....	....	....	..	..	63

Table No. 39 shows the mortality from diphtheria by age periods from 1884 to 1893 inclusive. It is gratifying to be able to record the fact that in the year 1893 the death-rate from this disease was lower than for any year heretofore reported. The number of deaths fell off more than one half as compared with the previous year. It will also be observed that there has been a steady diminution in the mortality from diphtheria in New Hampshire since 1889. It is not unreasonable to suppose that this may be in a measure, if not largely, due to the increased activity of local boards of health in carrying out isolation and disinfection.

CROUP.

TABLE No. 40.

Mortality from Croup from 1884 *to* 1893, *inclusive, by Ages.*

YEARS.	Under 1.	1 to 5.	5 to 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Unknown.	Total.
1884.....	8	35	6	....	....	....	....	....	....	....	....	....	..	49
1885.....	20	41	9	....	....	1	2	....	1	....	....	....	..	74
1886.....	13	40	10	1	....	....	....	....	....	....	....	....	..	64
1887.....	26	48	7	2	....	....	....	....	....	....	1	....	..	84
1888.....	16	67	9	....	....	....	1	....	....	....	1	....	..	94
1889.....	11	65	11	1	....	....	....	....	....	....	....	....	..	88
1890.....	16	41	6	1	....	....	....	....	....	....	....	....	..	64
1891.....	11	32	10	2	....	....	....	....	....	....	....	....	1	56
1892.....	6	32	5	1	1	....	....	....	....	....	....	....	..	45
1893.....	8	16	10	2	..	....	....	....	....	....	....	....	..	36

Table No. 40 shows the mortality from croup from 1884 to 1893 inclusive, by age periods. This table corresponds in its ratios very closely to the corresponding table (No. 39) relating to diphtheria. It will be seen that, like diphtheria, there has been a constant diminution in the mortality from this disease since 1888. There is no especial reason why croup and diphtheria should be any longer separated in statistical tables, inasmuch as membranous croup and diphtheria are now deemed by the best authorities to be the same disease.

TABLE No. 41.

Mortality from Croup and Diphtheria from 1884 *to* 1893, *inclusive.*

YEARS.	Deaths.			Percentages of deaths to deaths from all causes.			Death-rates per 10,000.		
	Croup.	Diphtheria.	Total.	Croup.	Diphtheria.	Total.	Croup.	Diphtheria.	Total.
1884.....	49	110	159	.79	1.77	2.56	1.36	3.06	4.42
1885.....	74	78	152	1.19	1.25	2.44	2.04	2.15	4.19
1886.....	64	156	220	.99	2.41	3.40	1.75	4.27	6.02
1887.....	84	177	261	1.29	2.73	4.02	2.28	4.81	7.09
1888.....	94	103	197	1.37	1.50	2.87	2.53	2.77	5.30
1889.....	88	210	298	1.31	3.13	4.44	2.35	5.61	7.96
1890.....	64	164	228	.86	2.21	3.08	1.69	4.32	6.02
1891.....	56	160	216	.79	2.20	2.10	1.48	4.22	5.69
1892.....	45	134	179	.56	1.69	2.25	1.18	3.50	4.68
1893.....	36	63	99	.47	.82	1.29	.93	1.63	2.57
Total	654	1,355	2,009	.....	.....	.....	.....	.....	.....
Average .	65	135	201	.96	1.97	2.84	1.76	3.63	5.39

In table No. 41 croup and diphtheria are combined for the purpose of comparison. The number of deaths, percentages of deaths to deaths from all causes, and the death-rate to each 10,000 living persons from 1884 to 1893 inclusive, is given.

TYPHOID FEVER.

TABLE No. 42.

Mortality from Typhoid Fever from 1884 *to* 1893, *inclusive.*

YEARS.	Deaths.	Percentages of deaths to deaths from all diseases.	Death-rates per 10,000 living (estimated population).
1884	137	2.21	3.81
1885	136	2.19	3.75
1886	194	3.01	5.31
1887	134	2.06	3.64
1888	150	2.18	4.04
1889	161	2.40	4.30
1890	143	1.94	3.79
1891	170	2.42	4.48
1892	109	1.36	2.85
1893	121	1.58	3.14
Total	1,455	.....	.....
Average	145	2.13	3.91

Table No. 42 exhibits the mortality from typhoid fever from 1884 to 1893 inclusive. It will be seen for the latter year that the total number of deaths from this disease was 121, a slight increase over the number reported for the previous year, but lower than the average for the past ten years. The death-rate for the years given is also calculated in percentages.

TABLE No. 43.

Mortality from Typhoid Fever from 1884 *to* 1893 *inclusive, by Ages.*

YEARS.	Under 1.	1 to 5.	5 to 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Unknown.	Total.
1884...	5	10	7	11	21	34	12	8	7	8	8	3	3	137
1885...	2	7	7	11	20	34	14	8	7	10	11	3	2	136
1886...	2	6	15	12	33	51	16	12	15	14	16	2	....	194
1887...	2	6	1	16	22	41	17	8	7	6	5	2	1	134
1888...	3	13	4	11	26	39	12	8	8	9	8	3	6	150
1889...	4	5	9	14	26	50	13	14	10	5	6	4	1	161
1890...	1	3	10	11	24	33	18	14	10	7	7	3	2	143
1891...	1	3	14	12	27	52	17	15	8	9	8	3	1	170
1892...	1	6	4	10	17	24	18	8	5	6	3	4	3	109
1893...	1	8	3	9	23	29	22	10	5	5	3	1	2	121

Table No. 43 shows the mortality from typhoid fever by age periods from 1884 to 1893, inclusive.

KIDNEY DISEASES.

TABLE No. 44.

Mortality from Bright's Disease, Nephritis, and other Kidney Diseases, and from Dropsy, with Ratio to Total Mortality, from 1884 *to* 1893, *inclusive.*

YEARS.	Total mortality from all causes.	Deaths from Bright's disease, nephritis, and other kidney diseases.	Ratio to total mortality per 1,000.	Deaths from dropsy.	Ratio to total mortality per 1,000.	Totals.	Ratio to total mortality per 1,000.
1884.....	6,194	140	22.60	80	12.91	220	35.51
1885.....	6,201	157	25.32	90	14.51	247	39.83
1886.....	6,426	143	22.25	83	12.92	226	35.17
1887.....	6,479	163	25.16	79	12.19	242	37.35
1888.....	6,854	154	22.47	75	10.94	229	33.41
1889.....	6,696	200	29.87	62	9.26	262	39.13
1890.....	7,368	201	27.28	53	7.19	254	34.47
1891.....	7,310	219	29.96	41	5.61	260	35.57
1892.....	7,988	222	27.99	43	5.38	265	33.17
1893.....	7,663	194	25.32	49	6.39	243	31.71

Table No. 44 shows the mortality from kidney diseases from 1884 to 1893, inclusive, together with ratios to the total mortality per 1,000. It will be seen by this table that the death-rate from kidney diseases for 1893 was a little less than that of the previous year and lower than has been returned since 1888, and the percentage to the total mortality a little lower than has heretofore been recorded.

SCARLET FEVER.

TABLE No. 45.

Mortality from Scarlatina from 1884 *to* 1893, *inclusive.*

YEARS.	Deaths.	Percentage of deaths to deaths from all causes.	Death-rates per 10,000 living population.*
1884	52	.83	1.44
1885	53	.85	1.46
1886	21	.32	.57
1887	26	.40	.70
1888	34	.49	.91
1889	18	.26	.48
1890	16	.21	.42
1891	13	.18	.34
1892	27	.33	.71
1893	52	.67	1.35
Total	312	.....	.....
Average	31	.45	.84

* Population estimated for all but census years.

Table No. 45 shows the number of deaths from scarlet fever for the past ten years. It will be seen that for several years there was a steady diminution in the mortality from this disease down to and including 1891, since which time the mortality has increased, and largely during the past year.

MEASLES.

TABLE No. 46.

Mortality from Measles from 1884 *to* 1893, *inclusive,*

YEARS.	Deaths.	Percentage of deaths to deaths from all causes.	Death-rate per 10,000 living population.*
1884	3	.04	.08
1885	45	.72	1.24
1886	18	.28	.49
1887	39	.60	1.06
1888	55	.80	1.48
1889	16	.23	.42
1890	9	.12	.23
1891	19	.26	.50
1892	24	.30	.62
1893	32	.41	.83
Total	260	.....	.....
Average	26	.38	.69

* Population estimated for all but census years.

Table No. 46 shows the mortality from measles for the ten years included in the table. The number of deaths returned from this disease in 1893 was 32, an increase over the last four years, and greater than has been returned since 1888.

TABLE 47.

Mortality from Measles from 1884 *to* 1893, *inclusive, by Ages.*

YEARS.	Under 1.	1 to 5.	5 to 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Unknown.	Total.
1884...	1	1	....	....	1	....	....	....	....	....	....	....	....	3
1885...	12	26	5	1	1	....	....	....	....	....	....	....	....	45
1886...	5	13	....	....	....	....	....	....	....	....	....	....	....	18
1887...	19	10	2	1	3	....	2	1	....	1	....	....	....	39
1888...	14	20	6	3	2	2	5	1	1	....	....	1	....	55
1889...	2	6	1	....	2	2	1	....	1	....	....	....	1	16
1890...	5	4	....	....	....	....	....	....	....	....	....	....	....	9
1891...	5	6	2	....	2	....	1	1	....	1	....	....	1	19
1892...	7	11	....	1	1	3	....	....	1	....	....	....	....	24
1893...	9	14	3	2	1	1	1	....	....	....	1	....	....	32

Table No. 47 gives the mortality from measles for the ten years included by age periods. It will be seen by this table that this is a disease chiefly of early life. It is also demonstrated by this table that the disease is of too great importance to be ignored, so far as restrictive measures are concerned, by local boards of health and the public.

AN OUTBREAK OF SMALL-POX.

On the evening of April 20, 1895, the following telegram was received:

NEWPORT, N. H.

IRVING A. WATSON, M. D.:

A case of small-pox in town. Come immediately. Answer.

(Signed) D. M. CURRIER.

On Monday, April 22, the secretary of the board took the first train for Newport, and there met the local board of health. The board reported that on April 20 a Mr. Bartlett, who was living in a small house adjacent to the residence of a Mr. Cain, came to the office of the board and reported that in his opinion Mr. Cain was ill with small-pox. Drs. Currier and Darling, of the board of health, taking with them as counsel Dr. Swett, an old and experienced practitioner of medicine, visited Mr. Cain, and the case was pronounced to be unmistakably small-pox in the pustular stage. The patient was being treated by his own son, Dr. J. L. Cain, who had pronounced the case to be measles, and who up to that time had not reported it as small-pox.

Upon the return of the board from the case (which was about a mile out of the village of Newport), the telegram above quoted was sent to the office of the State Board of Health.

The secretary of the board, after learning the above facts, proceeded with Drs. Currier, Darling, and Swett to the residence of Mr. Cain, and examined the case, which was found to be in the pustular stage, fully developed, and of a very severe type.

Between the discovery of the case by the local board of health on Saturday and the visit of the secretary of the State Board of Health on Monday, the local board had made careful investigation as to

where the disease came from, and arrived at the conclusion that it was brought to Mr. Cain's house by a Mr. Bartlett, who had recently come from Chicago, and who had, some two or three weeks before, some eruptions which were regarded as chicken-pox. It seems that Bartlett came to the Sugar River House, Newport, February 25, directly from Chicago, and that about the 4th or 5th of March the proprietor of the above mentioned house noticed an eruption upon the face and hands of Mr. Bartlett, and ordered him to leave the house, which he did on the evening of March 6, going directly to the little house owned by Mr. Cain, and only a few feet distant from the latter's residence. It was therefore evident that Mr. Bartlett had communicated the disease to Mr. Cain. Mr. Bartlett had with him his two sons, who had a very mild type of varioloid. A quarantine was placed upon the infected premises.

On the 26th day of April, 1895, Mr. Lovering of Croydon called at the office of the State Board of Health, as a representative of the selectmen of that town, to notify the board that small-pox had appeared in Croydon; that it had appeared in three families, to wit: Charles Rowell's, Charles Davis's, and William W. Partridge's.

The secretary of the board proceeded to Croydon and investigated the outbreak, learning the following facts: That Mrs. Rowell went to Mr. Cain's house at Newport, on the 23d day of March, and there did general housework for seven days. In the meantime her son, fifteen years of age, visited her, and remained with her at Mr. Cain's over night. Mrs. Rowell and her son then went home to Croydon, and on the 8th day of April, Mrs. Rowell was taken ill, and about the same time her son showed indications of an eruptive disease. These cases were seen by a physician and pronounced to be measles.

Mrs. Charles Davis, a neighbor, living within one fourth of a mile, or thereabouts, of the said Rowells, and having three children, thought it would be a good idea for them to have this disease; so, taking one of her daughters, she visited the Rowells, and contracted small-pox. She came down with the disease on the 19th day of April, and died April 25.

A man by the name of Howard staid over night at Rowell's, contracted the disease, and went to another part of the town to work for Mr. Partridge, above mentioned, and came down with the disease about the same time that it appeared in the Davis family.

The disease was not recognized as small-pox until about the time of the death of Mrs. Davis. As soon as the nature of the disease was known, all persons who were exposed, and many others, were vaccinated.

It will be seen that a clear line of infection was established from the first case (Bartlett) to Cain's, from Cain's to Rowell's, from Rowell's to Davis's, and from Davis's to Partridge's.

On the 28th day of April the following telegram was received from Claremont:

DR. IRVING A. WATSON, *Secretary State Board of Health*:
There are four cases of small-pox in town.
(Signed) E. F. HOUGHTON,
Chairman Board of Health.

The secretary proceeded to Claremont to investigate the outbreak there, and at the office of the local board of health was given the facts to date substantially as follows:

One Ambrose Barron was at work in Newport, and boarded at the Sugar River House, at which place it will be remembered Bartlett, the first case, was boarding. Barron remained at this house until March 19, when he left for Claremont. This was thirteen days after Bartlett left the Sugar River House, and Barron must have been coming down with the disease at the time he left, for three days later, March 22, he consulted Dr. Theriault of Claremont, who reported the case to the board of health as measles. Barron's family consisted of self, wife, and child, fourteen months old. He lived in an upper tenement on River street. On the 1st of April, Barron moved to an upper tenement in a house on the corner of Elm and Front streets.

On April 13, the physician above named reported two cases of measles in a family by the name of Forcier, who lived in the lower tenement of the house on River street from which Barron moved. On April 27 three more cases were reported from the same family, as measles. On April 27, the diagnosis was changed to small-pox.

It will be seen by these dates that small-pox existed in the town of Claremont something like thirty-seven days before its presence was known to the health authorities. Many relatives of the persons who were infected with the disease visited them, so that from these sources alone there were many exposures. In addition to this, without any precaution whatever against carrying the disease,

Barron had gone to work in a shoe shop. It was also found that a party had been held at one of the houses in which there was small-pox. All these conditions had taken place before the presence of the disease was known to the authorities.

The secretary of the State Board of Health held a conference with the local board of Claremont, also with the board of education, and the board of selectmen. It was determined to take the most prompt and effective measures possible. To that end, the town decided to erect, immediately, a hospital, about a mile from the village, to which should be conveyed all the small-pox cases. The situation was so grave that, upon application, the governor and council authorized the State Board of Health to act under the provisions of the law of 1893, which gave the State Board of Health full authority to carry out such measures as might be deemed best.

The town had a hospital ample for over thirty patients ready for occupancy in less than a week. In the meantime a most efficient quarantine was maintained over the infected houses by the local board of health.

Under the provisions of the law referred to, Dr. George Cook of Concord was appointed a medical inspector of this Board, and ordered to proceed to Claremont to take charge of the work under the instructions given by the State Board of Health and to coöperate with the local board in stamping out the disease. Dr. Cook most faithfully and conscientiously performed the duties assigned him, from May 4 to June 8, at which time private affairs compelled him to resign. Dr. E. F. Houghton of Claremont was appointed to fill the position made vacant by the resignation of Dr. Cook.

It is perhaps unnecessary to say that the management of this outbreak, considering the large number of exposures that had already taken place, was no easy matter. In addition to caring for the patients, a daily inspection of a large number of persons was maintained in order to discover promptly the appearance of the diease among those that might have been exposed to it. Inasmuch as measles were prevailing at the same time, most careful judgment in diagnosing was required.

In a final report to this board, Dr. Houghton says:

"There have been twenty-six cases of small-pox in Claremont, as follows: Eleven cases of varioloid, two cases discrete small-pox, one case semi-confluent, and twelve cases of confluent.

"Twenty-four cases recovered, and two died.

"The cases were from fourteen families in thirteen houses, as follows: Forcier family six, Noley four, Chartier three, Barron two, Charron two, and nine families one each. The first case, Ambrose Barron, was taken sick March 19, the last case May 26.

"It was first known to the board of health that there was small-pox in town April 27, at which time there was, or had been, thirteen cases in five families named above, as follows: Forcier six, Barron two, Charron two, Chartier two, and Noley one.

"These five houses were immediately quarantined and guarded. The patients were moved to the small-pox hospital May 6, at which time six cases had recovered and one had died. Nineteen cases have been taken to the small-pox hospital, of which eighteen have recovered and one has died."

On May 6 the secretary of this board was requested to go to Sunapee to examine a case supposed to be small-pox. The request was immediately complied with, and a case of varioloid was found in the person of A. D. Noyes, who, on April 21, had called upon the Rowell family in Croydon, remaining in the house about one hour, and supposing at that time that the family were infected with measles. Mr. Noyes was promptly isolated at an old farm house a mile or so out of the village of Sunapee. He was not confined to his bed and speedily recovered.

The total number of persons infected in this outbreak was thirty-eight. Notwithstanding the disease had existed for more than a month before it was discovered, it was completely controlled and stamped out in nine weeks, which fact alone is the highest commendation that could be given to the executive ability of the persons connected with its management—chiefly Drs. Cook and Houghton, supported at every point and in every detail by the local and state authorities.

It is probable that a more connected and detailed account of this outbreak will appear in the next report of this board, as this record is hastily written just as this report is leaving the printer's hands. It is a pleasure to announce that there is not at this time (July 1, 1895) a case of small-pox in New Hampshire.

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